**3GPP TSG RAN WG1 #108-e R1-2nnnnn**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda Item: 8.16.2**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for supporting NR from 52.6 GHz to 71 GHz**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion/approval [108-e-R17-UE-features-52-71GHz-01] during RAN1 #108-e. According to the Chairman’s Notes:

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| [108-e-R17-UE-features-52-71GHz-01] Email discussion on UE features for supporting NR from 52.6 GHz to 71 GHz – Ralf (AT&T)* 1st check point: February 25
* Final check point: March 3
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The following was discussed and/or agreed during RAN1 #108-e within the scope of [108-e-R17-UE-features-52-71GHz-01]. All proposals are based on the latest RAN1 UE features list for Rel-17 NR in [1].

# Summary of Contributions Submitted to RAN1 #108-e

The following is the moderator’s summary of contributions submitted to RAN1 #108-e in this agenda item.

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|  24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 DL support |  1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  | Yes | N/A | FR2-2 is not supported | per band | N/A | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] | * Clarity that ”non-initial access” refers to SSB support and reference signals
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| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 | Yes | N/A | UL in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] | FG 24-1aFG24-1a should be a mandatory FG to support FG2-2, we propose to remove the corresponding bracket.**Proposal 1: for FG24-1a,** * **removing bracket on “[A UE that supports FR2-2 must indicate this FG is supported]”.**
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| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | [A UE that supports FG 24-2 must indicate this FG is supported][Note: This FG is only supported in bands for shared spectrum operation] | Optional withcapability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, there were discussion and no consensus on whether the FG24-1b and FG24-4b should be restricted in unlicensed band. Although the scope of WID [2] might not be crystal clear depending on different interpretation from companies, the main motivation to introduce longer PRACH sequence in RAN1 is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other hand, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So we propose to remove the bracket on the sentence of “[Note: This FG is only supported in bands for shared spectrum operation]” in the note column for FG24-1b and FG24-4b. There was discussion on whether FG24-1b should be supported if UE report the capability of FG24-2 (120KHz SSB support for initial access in FR2-2). To our understanding, it is not necessary because all basic uplink capabilities to fulfil the initial access procedures have been captured in FG24-1a, which is already the prerequisite of 24-2. Moreover, FG24-2 is applied for both licensed band unlicensed band while FG24-1b is only for unlicensed band from our perspective. The sentence of “[A UE that supports FG 24-2 must indicate this FG is supported]” should be deleted from the note column of FG24-1b.***Proposal 1: Remove the bracket on the sentence of “[Note: This FG is only supported in bands for shared spectrum operation]” in the note column for FG24-1b and FG24-4b*** ***Proposal 2: Delete the sentence of “[A UE that supports FG 24-2 must indicate this FG is supported]” in the note column of FG24-1b.***

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz | 24-1a | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | Note: This FG is only supported in bands for shared spectrum operation | Optional withcapability signalling |

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| Vivo [3] | Proposal 1: FG 24-1b and 24-4b are only supported in bands for shared spectrum operation.On 24-1b, another issue is whether “A UE that supports FG 24-2 must indicate this FG is supported”, the same handling as NRU should be adopted, i.e. 10-27 in [2]. It is clearly that wideband PRACH is not a basic FG for any scenario. Therefore, there is no need to bundle 24-2 and 24-1b together. Proposal 2: For 24-1b, remove “A UE that supports FG 24-2 must indicate this FG is supported”. |
| OPPO [4] | In our opinion, the feature of wideband PRACH is not needed and motivated in the case where PSD limitation is not imposed. We propose to clearly mention the condition with PSD limitation as other FGs and remove the confusing description. Moreover, for UE supporting FG 24-2 to must indicate supporting FG 24-1b is not needed in the region where PSD limitation is not required. Thus, we suggest to remove this ‘must indicate’ requirement. **Proposal 2: for FG24-1b,** * **replacing “[Note: This FG is only supported in bands for shared spectrum operation]” with “This FG is only supported in bands under PSD limitation in shared spectrum operation”.**
* **removing “[A UE that supports 24-2 must indicate this FG is supported]”.**
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| ZTE/Sanechips [5] | For FG 24-1b, the remaining issues are whether Wideband PRACH is mandatory for FR2-2 UL and whether it is only applied for the unlicensed band. For the former, we think that wideband PRACH can bring better performance, especially for coverage. So propose this FG as a mandatory feature for FR2-2 UL, that is, support removing yellow highlight and brackets of “[A UE that supports FG 24-2 must indicate this FG is supported]”. If it is agreed, we suggest to merge FG 24-1b into FG 24-1a. However, for the second issue, according to the revised WID, we can observe that wideband PRACH is not limited to operation with shared spectrum. The revised WID objective is as follows:

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| * Physical layer aspects including [RAN1]:
	+ Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
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“operation in shared spectrum” mentioned in the above objective is just to apply to RO configuration for non-consecutive RACH occasions (RO) in time domain, not for PRACH sequence lengths. Consequently, the PRACH sequence lengths part of this objective applies to both operation with/without shared spectrum. With this consideration, we propose to remove wording “[Note: This FG is only supported in bands for shared spectrum operation]” .Note that the same method used for 120kHz PRACH SCS can be applied to 480 kHz PRACH SCS(FG 24-4b).**Proposal 2: Modify FG 24-1b as follows:**

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| 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[~~A UE that supports FG 24-2 must indicate this FG is supported~~]~~~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | Optional withcapability signalling |

**Proposal 3: Propose to merge FG 24-1b into FG 24-1a, as follows:**

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| 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 139/571/11512. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 | Yes | N/A | UL in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |
| ~~24-1b~~ | ~~Wideband PRACH for 120 kHz in FR2-2~~ | ~~Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz~~  | ~~24-1a~~ | ~~Yes~~ | ~~N/A~~ | ~~Wideband PRACH for 120 kHz in FR2-2 is not supported~~ | ~~Per band~~ | ~~N/A~~ | ~~N/A~~ | ~~N/A~~ | ~~[A UE that supports FG 24-2 must indicate this FG is supported]~~~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | ~~Optional withcapability signalling~~ |

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| Nokia/Nokia Shanghai Bell [6] | * + It is fine to allow the usage in licensed spectrum if and only if there are no design changes. This would be still conforming with the intention of the WID.
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| NTT DOCOMO, INC. [7] | For FG24-1b and 1c, there is an FFS on whether to have a Note that makes these features mandatory in a certain case, e.g., when a UE supports FG24-2 (i.e., SA operation in FR2-2 with 120kHz SCS). We actually support the Note, i.e., prefer to ask UEs supporting SA to mandatorily support these FGs to make them available even during initial access. Without the Note, these FGs will be just optional ones in any scenario, which means gNB in general cannot configure them for initial access since gNB does not have prior knowledge on whether UEs support them or not. believe it is essential to have such a Note for these features since NW may not be able to configure these features for any UEs during initial access. We believe these FGs are well understood as features for improving coverage performance under PSD limitation. Thus, if they are not available during initial access, practical coverage is limited in SA scenario even if they are available after initial access. Although SA operation without them could work (with limited coverage), we hope to make these FGs available regardless of scenarios, including SA. For FG24-1b, there is another FFS on whether to limit the applicable case within bands for shared spectrum operation. In our understanding, this feature is to avoid coverage degradation due to PSD limitation that needs to be considered in unlicensed band in some regions. Also, we are not sure whether it is beneficial even in licensed band operation where PSD limitation does not need to be considered. Unless there is clear gain by this feature in licensed band, we are ok with limiting this FG for unlicensed band only.

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | A UE that supports FG 24-2 must indicate this FG is supportedNote: This FG is only supported in bands for shared spectrum operation | Optional withcapability signalling |

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| Intel Corporation [8] | For UE operating with unlicensed SA mode, it needs to also support wideband PUCCH and wideband PRACH together. The main reason is that the wideband PUCCH and wideband PRACH were specifically targeted to improve the coverage issues due to power spectral density in unlicensed bands. However, if the UE optionally do not support this feature, this would shrink the potentially coverage for unlicensed cell deployments. Therefore, all UEs that is able to operate uplink transmission should support wideband PUCCH and wideband PRACH. Otherwise, the main motivation to introduce the feature is lost.Based on this we propose the following for 120 kHz:**Proposal 1:*** FG 24-1b and 24-1c add the note that “A UE that support FG24-2 must indicated this FG is supported”.
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| Ericsson [9] | In the previous meeting, there was discussion on whether or not FG 24-1b (wideband PRACH) and FG 24-1c (multi-RB PUCCH) should be mandatory for a UE that supports standalone operation in FR2-2, i.e., a UE that supports FG 24-2. In our view, these features should not be mandatory since not all deployment scenarios are coverage limited. We understand that for a standalone deployment, there is no mechanism to indicate UE capability for wideband PRACH/multi-RB during initial access; however, if a network indicates in SIB1 that either of these features should be used, and the UE does not support them, the UE simply cannot access the system.However, even if the network indicates legacy PRACH (L = 139) and legacy PUCCH (single RB), it is still useful for the UE to indicate capability for FG 24-1b/c after initial access from the perspective that the network can capture statistics on UE support for these features. Once a significant fraction of the UE fleet supports wideband PRACH/multi-RB PUCCH, then the features can be activated. This can be useful for an operator to decide which features should be deployed and when in a network. Hence, in our view the feature should still be defined as "Optional with capability signaling."Regarding FG 24-1b (wideband PRACH), our understanding of the WID is that this feature is not restricted to shared spectrum operation only. While we think that FG 24-1c (multi-RB PUCCH) should also not be restricted since there may be PSD limitations even in licensed bands in FR2-2, we acknowledge that a strict reading of the WID [2]seems to preclude this feature for licensed bands unfortunately.1. Modify FG 24-1b and FG 24-1c as follows such that: (1) these FGs are not mandatory for standalone operation, and (2) FG 24 1-b is not restricted to shared spectrum operation only.

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| 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a | ~~[A UE that supports FG 24-2 must indicate this FG is supported]~~~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | Optional withcapability signalling |

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| Apple [10] | 1. Support removal of brackets around the statement [Note: This FG is only supported in bands for shared spectrum operation] based on WID:

“Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum” Interpretation is that this is for the entire sentence similar to PUCCH and not just for RO configuration. 1. Support removal of brackets around the statement [A UE that supports 24-2 must indicate this FG is supported] based on need for compensation for PSD
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| Samsung [11] | One remaining issue left for FG 24-1b (i.e., wideband PRACH for 120 kHz in FR2-2) is whether to mandate this FG when FG 24-2 is supported (i.e., 120 kHz SSB for initial access in FR2-2). It is true that supporting wideband PRACH can be beneficial in increasing the coverage of PRACH transmission, however, this feature may not be considered as mandatorily required for implementing initial access to the system, since FR2-1 only has PRACH with short sequence length as 139 and no significant coverage issue was found. Hence, we don’t support mandating this FG when FG 24-2 is supported. Another remaining issue left for FG 24-1b and 24-b (i.e., wideband PRACH for 120 kHz and 480 kHz in FR2-2, respectively) is whether to restrict these FGs for bands with shared spectrum operation only. This discussion originates from an unclear description of the working scope from the WID, and technically the benefit of wideband PRACH is from the PSD limitation on shared spectrum operation. It’s better to ask guidance from RAN plenary on the intention and working scope related to this issue, such that no time will be wasted in RAN1 discussion. **Proposal 1: For FG 24-1b and 24-4b:*** **Remove the note “A UE that supports FG 24-2 must indicate this FG is supported” for FG 24-1b.**
* **Ask guidance from RAN plenary on whether FG 24-1b and 24-4b are applicable other than shared spectrum operation.**
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| MediaTek Inc. [12] | Whether the FG 24-1b and FG 24-4b should be included as basic FR2-2 UL FGs was discussed in RAN1 #107-e meeting. Some company mentioned that PRACH is a fundamental channel in initial access and supporting such feature as basic functionality is necessary. However, the motivation of introducing such FG is to comply with regulation, which varies based on different regions. Therefore, we prefer to allow UE to have the option on whether to support the FG based on different regulations.Proposal 1: Modify FG 24-1b and FG24-4b as follows

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  |  | Optional ~~[~~with~~/without]~~capability signalling[Note: This FG is only supported in bands for shared spectrum operation]~~[A UE that supports 24-2 must indicate this FG is supported]~~ |

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| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | One of remaining issues for wideband PRACH is whether to support this feature only for shared spectrum operation or to support for both unlicensed and licensed band operation. In our view, wideband PRACH should be supported only for shared spectrum operation, since the motivation to introduce wideband PRACH in FR2-2 was to compensate coverage loss caused by power spectrum density restriction in regulatory requirement, similar to multi-RB PUCCH format 0/1/4.**Proposal #4: Update FGs 24-1b and 24-4b as follows.**

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | Wideband PRACH for 120 kHz in FR2-2 is not supported | [A UE that supports FG 24-2 must indicate this FG is supported]Note: This FG is only supported in bands for shared spectrum operation |

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | [A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | In the note column, there is still one pending issue of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]”. According to the agreement in RAN1#107bis-e, FG24-1c is only applicable to “bands under PSD limitation in shared spectrum operation”. However, FG24-1a, FG24-2 or even the whole FR2-2 would include both licensed band and unlicensed band. It is not necessary for UE only support licensed band to report this capability. For the UE operating on the unlicensed band without PSD limitation, this FG is also redundant. Thus, we propose to delete the sentence of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]”in the note column. ***Proposal 3: Delete the sentence of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]” in the note column of FG24-1c.***

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|  | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Vivo [3] | Proposal 3: For 24-1c, remove “A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported”. |
| OPPO [4] | Similar as FG24-1b, the feature of multi-RB PUCCH format should be supported under PSD limitation case, we propose to remove the confusing description.**Proposal 3: for FG24-1c,** * **removing “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]”.**
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| ZTE/Sanechips [5] | Considering the motivation of introducing multi-RB PUCCH, we think that this FG can be considered as mandatory at least for unlicensed band and UL related deployment scenarios. For this point of view, we tend to support removing yellow highlight and brackets of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]”.**Proposal 4: Modify FG 24-1c as follows:**

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| 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[~~A UE that supports ~~[~~24-1a/24-2/FR2-2~~]~~ must indicate this FG is supported~~]~~This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [6] | * + It is fine to allow the usage in licensed spectrum if and only if there are no design changes. This would be still conforming with the intention of the WID.
 |
| NTT DOCOMO, INC. [7] | For FG24-1b and 1c, there is an FFS on whether to have a Note that makes these features mandatory in a certain case, e.g., when a UE supports FG24-2 (i.e., SA operation in FR2-2 with 120kHz SCS). We actually support the Note, i.e., prefer to ask UEs supporting SA to mandatorily support these FGs to make them available even during initial access. Without the Note, these FGs will be just optional ones in any scenario, which means gNB in general cannot configure them for initial access since gNB does not have prior knowledge on whether UEs support them or not. believe it is essential to have such a Note for these features since NW may not be able to configure these features for any UEs during initial access. We believe these FGs are well understood as features for improving coverage performance under PSD limitation. Thus, if they are not available during initial access, practical coverage is limited in SA scenario even if they are available after initial access. Although SA operation without them could work (with limited coverage), we hope to make these FGs available regardless of scenarios, including SA.

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supportedThis FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

 |
| Intel Corporation [8] | For UE operating with unlicensed SA mode, it needs to also support wideband PUCCH and wideband PRACH together. The main reason is that the wideband PUCCH and wideband PRACH were specifically targeted to improve the coverage issues due to power spectral density in unlicensed bands. However, if the UE optionally do not support this feature, this would shrink the potentially coverage for unlicensed cell deployments. Therefore, all UEs that is able to operate uplink transmission should support wideband PUCCH and wideband PRACH. Otherwise, the main motivation to introduce the feature is lost.Based on this we propose the following for 120 kHz:**Proposal 1:*** FG 24-1b and 24-1c add the note that “A UE that support FG24-2 must indicated this FG is supported”.
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| Ericsson [9] | In the previous meeting, there was discussion on whether or not FG 24-1b (wideband PRACH) and FG 24-1c (multi-RB PUCCH) should be mandatory for a UE that supports standalone operation in FR2-2, i.e., a UE that supports FG 24-2. In our view, these features should not be mandatory since not all deployment scenarios are coverage limited. We understand that for a standalone deployment, there is no mechanism to indicate UE capability for wideband PRACH/multi-RB during initial access; however, if a network indicates in SIB1 that either of these features should be used, and the UE does not support them, the UE simply cannot access the system.However, even if the network indicates legacy PRACH (L = 139) and legacy PUCCH (single RB), it is still useful for the UE to indicate capability for FG 24-1b/c after initial access from the perspective that the network can capture statistics on UE support for these features. Once a significant fraction of the UE fleet supports wideband PRACH/multi-RB PUCCH, then the features can be activated. This can be useful for an operator to decide which features should be deployed and when in a network. Hence, in our view the feature should still be defined as "Optional with capability signaling."Regarding FG 24-1b (wideband PRACH), our understanding of the WID is that this feature is not restricted to shared spectrum operation only. While we think that FG 24-1c (multi-RB PUCCH) should also not be restricted since there may be PSD limitations even in licensed bands in FR2-2, we acknowledge that a strict reading of the WID [2]seems to preclude this feature for licensed bands unfortunately.1. Modify FG 24-1b and FG 24-1c as follows such that: (1) these FGs are not mandatory for standalone operation, and (2) FG 24 1-b is not restricted to shared spectrum operation only.

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| --- | --- | --- | --- | --- | --- |
| 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | ~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Apple [10] | 1. Can support removal of brackets around the statement [A UE that supports [24-1a/24-2] must indicate this FG is supported] with removal for 24-1a and 24-2 but not for FR2-2.
 |
| Samsung [11] | The remaining issue left for FG 24-1c (i.e., Multi-RB support PUCCH format 0/1/4 for 120 kHz in FR2-2) is whether to mandate this FG when FG 24-1a/24-2/FR2-2 is supported. Similar to the comments for FG 24-1b, the intention of supporting this feature is mainly due to the PSD limitation with shared spectrum operation, which can be considered as an optimization of transmission power, but not essentially required to implement the system. In this sense, a UE should not be mandated to support multi-RB PUCCH formats in FR2-2. **Proposal 2: FG 24-1c, remove the note “A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported”.** |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal 3: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz |  | Optional with capability signalling~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only supported in bands under PSD limitation in shared spectrum operation |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A | FFS: to extend this FG to other frequency ranges  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, several companies proposed to extend the support of multiple PDSCH/PUSCH scheduling by single DCI to other frequency ranges, e.g. FR2-1 and FR1. We also share the similar view because these FGs can reduce UE implementation complexity and power consumption on PDCCH monitoring while maintain the high throughput. Moreover, there were also precedents in NRU Rel-16. For example, multiple PUSCH scheduling by single DCI was originally introduced for unlicensed band in FR1 and then extended to licensed band in FR1 and FR2-1. The designs in FR2-2 in Rel-17 are following the same design as in Rel-16 except for allowing discontinuous resource allocation in time domain. ***Proposal 4: Support to extend FG24-1d and FG24-1e to FR2-1 and FR1.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Vivo [3] | On 24-1d for 120KHz multi-PDSCH scheduling, it is not decided yet whether it can be extended to other frequency ranges. First of all, this FG may only be extended to FR2-2 since there is no 120KHz SCS in FR1. Besides, it seems that there is no strong motivation and use case to extend this FG to other frequency ranges. Proposal 4: For 24-1d, remove “FFS: to extend this FG to other frequency ranges”. |
| OPPO [4] | In the last version, there is an FFS to extend these FGs of multi-PDSCH/PUSCH scheduling by single DCI for 120kHz SCS to other frequency range. In our opinion, multi-PDSCH/PUSCH scheduling by single DCI is introduced mainly for 480kHz and 960kHz to reduce UE PDCCH monitoring capability for FR2-2, and is extended to 120kHz for FR2-2 for an unified design. There is no motivation to extend multi-PDSCH/PUSCH scheduling by single DCI for 120kHz to other frequency range, besides, extending these FGs to other frequency range is out of the WI scope for FR2-2. For these reasons, we do not support extending these FGs to other frequency range.**Proposal 4: for FG24-1d and FG24-1e,** * **removing “FFS: to extend this FG to other frequency ranges”.**
 |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] | * + Support that these FGs can be applicable to FR2-1 as well, as it provides power saving opportunities.
 |
| NTT DOCOMO, INC. [7] | For FG24-1d and FG24-1e, whether to extend it to other FR remains as a FFS. First, we would like to point out that this feature is defined per band. Thus, there is generally no significant reason to explicitly limit the applicable FR on UE feature list. Moreover, this FG is not essential for 120 kHz SCS even in FR2-2, while it is defined there. Therefore, as an optional capability, we think it would be ok to allow this FG to be supported for 120 kHz SCS in FR2-1 if there is a UE that want to support this. We do not support to have an explicit text to limit the applicable FR.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For these FGs, the open issue is whether multi-PDSCH/PUSCH scheduling should be extended to other frequency ranges (e.g., FR2-1 and even FR1). In our view, if a UE is capable of supporting these features, there is no reason for artificially restricting them to FR2-2. These features are generally useful regardless of frequency range, and it seems there would be no implementation issue for supporting at least FR2-1 in addition to FR2-2. We are also open to discuss extending to FR1; we think there should be no technical issue in doing so. Moreover, a UE can always indicate support or not for a given band in any frequency range since the capability signaling is already agreed to be "per-band."1. Modify FG 24-1d and FG 24-1e as follows such that these FGs are applicable at least to FR2-1 and FR2-2 (FR1 can be further discussed). Furthermore, clarify that for FG 24-1d, the HARQ enhancements are those required to enable multi-PDSCH scheduling.

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| --- | --- | --- | --- | --- | --- |
| 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements for supporting multi-PDSCH scheduling | 24-1 | ~~FFS: to extend this FG to other frequency ranges~~This feature group is applicable to both FR2-1 and FR2-2  | Optional with capability signalling |

 |
| Apple [10] | 1. For FG 24-1d, Multiple PDSCH scheduling by single DCI for 120kHz, do not extend this FG to other frequency ranges
 |
| Samsung [11] | Multiple PUSCH/PDSCHs scheduled by single DCI is supported mainly to resolve the issue of limited processing time for 480 and 960 kHz in FR2-2, and it’s generalized to 120 kHz in FR2-2 as well since the specification impact is minor. However, it doesn’t imply this feature can be easily generalized to other frequency ranges or other subcarrier spacings, since the device supporting FR2-2 may not be the same as the one supporting other frequency ranges or other subcarrier spacings, and such generalization should be avoided without proper justification. **Proposal 3: FG 24-1d and 24-1e, remove the note “FFS: to extend this FG to other frequency ranges”.** |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | In [1], UE capability to support multi-PXSCH scheduling DCI is captured as a separate FG for 120 kHz and as a component of basic DL/UL FGs for 480 or 960 kHz SCS (with FFS for DL). In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to frequency ranges other than FR2-2 (i.e., also for 15/30/60 kHz SCS). For 480 and 960 kHz SCS, it is preferred to confirm that multi-PXSCH scheduling DCI is defined as a component of corresponding basic DL/UL FGs.**Proposal #1: Extend the applicability of multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI to frequency ranges 1 and 2-1 in addition to FR2-2 and update FGs 24-1d and 24-1e accordingly, as follows.**

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| --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz or less than 120 kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS or less than 120 kHz SCS2. HARQ enhancements | Multiple PDSCH scheduling by single DCI for 120kHz or less than 120 kHz is not supported |  | Optional with capability signalling |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A | FFS: to extend this FG to other frequency ranges | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, several companies proposed to extend the support of multiple PDSCH/PUSCH scheduling by single DCI to other frequency ranges, e.g. FR2-1 and FR1. We also share the similar view because these FGs can reduce UE implementation complexity and power consumption on PDCCH monitoring while maintain the high throughput. Moreover, there were also precedents in NRU Rel-16. For example, multiple PUSCH scheduling by single DCI was originally introduced for unlicensed band in FR1 and then extended to licensed band in FR1 and FR2-1. The designs in FR2-2 in Rel-17 are following the same design as in Rel-16 except for allowing discontinuous resource allocation in time domain. ***Proposal 4: Support to extend FG24-1d and FG24-1e to FR2-1 and FR1.***

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|  | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] | In the last version, there is an FFS to extend these FGs of multi-PDSCH/PUSCH scheduling by single DCI for 120kHz SCS to other frequency range. In our opinion, multi-PDSCH/PUSCH scheduling by single DCI is introduced mainly for 480kHz and 960kHz to reduce UE PDCCH monitoring capability for FR2-2, and is extended to 120kHz for FR2-2 for an unified design. There is no motivation to extend multi-PDSCH/PUSCH scheduling by single DCI for 120kHz to other frequency range, besides, extending these FGs to other frequency range is out of the WI scope for FR2-2. For these reasons, we do not support extending these FGs to other frequency range.**Proposal 4: for FG24-1d and FG24-1e,** * **removing “FFS: to extend this FG to other frequency ranges”.**
 |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] | * + Support that these FGs can be applicable to FR2-1 as well, as it provides power saving opportunities.
 |
| NTT DOCOMO, INC. [7] | For FG24-1d and FG24-1e, whether to extend it to other FR remains as a FFS. First, we would like to point out that this feature is defined per band. Thus, there is generally no significant reason to explicitly limit the applicable FR on UE feature list. Moreover, this FG is not essential for 120 kHz SCS even in FR2-2, while it is defined there. Therefore, as an optional capability, we think it would be ok to allow this FG to be supported for 120 kHz SCS in FR2-1 if there is a UE that want to support this. We do not support to have an explicit text to limit the applicable FR.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For these FGs, the open issue is whether multi-PDSCH/PUSCH scheduling should be extended to other frequency ranges (e.g., FR2-1 and even FR1). In our view, if a UE is capable of supporting these features, there is no reason for artificially restricting them to FR2-2. These features are generally useful regardless of frequency range, and it seems there would be no implementation issue for supporting at least FR2-1 in addition to FR2-2. We are also open to discuss extending to FR1; we think there should be no technical issue in doing so. Moreover, a UE can always indicate support or not for a given band in any frequency range since the capability signaling is already agreed to be "per-band."1. Modify FG 24-1d and FG 24-1e as follows such that these FGs are applicable at least to FR2-1 and FR2-2 (FR1 can be further discussed). Furthermore, clarify that for FG 24-1d, the HARQ enhancements are those required to enable multi-PDSCH scheduling.

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| 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | ~~FFS: to extend this FG to other frequency ranges~~This feature group is applicable to both FR2-1 and FR2-2 | Optional with capability signalling |

 |
| Apple [10] | 1. For FG 24-1d, Multiple PDSCH scheduling by single DCI for 120kHz, do not extend this FG to other frequency ranges
 |
| Samsung [11] | Multiple PUSCH/PDSCHs scheduled by single DCI is supported mainly to resolve the issue of limited processing time for 480 and 960 kHz in FR2-2, and it’s generalized to 120 kHz in FR2-2 as well since the specification impact is minor. However, it doesn’t imply this feature can be easily generalized to other frequency ranges or other subcarrier spacings, since the device supporting FR2-2 may not be the same as the one supporting other frequency ranges or other subcarrier spacings, and such generalization should be avoided without proper justification. **Proposal 3: FG 24-1d and 24-1e, remove the note “FFS: to extend this FG to other frequency ranges”.** |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | In [1], UE capability to support multi-PXSCH scheduling DCI is captured as a separate FG for 120 kHz and as a component of basic DL/UL FGs for 480 or 960 kHz SCS (with FFS for DL). In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to frequency ranges other than FR2-2 (i.e., also for 15/30/60 kHz SCS). For 480 and 960 kHz SCS, it is preferred to confirm that multi-PXSCH scheduling DCI is defined as a component of corresponding basic DL/UL FGs.**Proposal #1: Extend the applicability of multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI to frequency ranges 1 and 2-1 in addition to FR2-2 and update FGs 24-1d and 24-1e accordingly, as follows.**

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|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz or less than 120 kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS or less than 120 kHz SCS | Multiple PUSCH scheduling by single DCI for 120kHz or less than 120 kHz is not supported |  | Optional with capability signalling |

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|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for initial access in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for initial access in FR2-2 | 1. Support 480KHz SSB for initial in FR2-2 | 24-2, 24-4, 24-4a | N/A | N/A | 480KHz SSB for initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with set2 = (4, 3) and (7, 3) symbols where set2 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b)  | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Perband | N/A | N/A | N/A | FFS: component description without a reference to other R15 FGs | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component for both FG24-4 and FG24-5.Following agreement on Group (2) SS monitoring for UE with multi slot PDCCH monitoring capability has been reached in RAN1#107bis-e. Thus, the sentence of “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” in FG24-4 and FG24-5 can be replaced with the yellow highlighted sentence in the agreement considering the guidance in the note column “FFS: component description without a reference to other R15 FGs”. **Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Further, if Group (2) SS monitoring capability is already described in FG24-4 and FG24-5, it does not need to be repeated in the corresponding advanced FG capabilities FG 24-4f and FG 24-5f. Therefore, we suggest to remove “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” from FG 24-4f and FG 24-5f.In RAN1#107e and RAN1#107bis-e, there is no consensus to introduce multi slot PDCCH monitoring capability with slot group of X=2 slots. Comparing with the already support capability of (Xs,Ys)=(4,2), the capability of (Xs,Ys)=(2,1) requires UE to at most monitor 4 occasions every 4 slots and every 2 monitoring occasions locate in the same slot. The UE complexity is increased significantly while the benefit is unclear. So we propose to change the component description back to “Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2)”.***Proposal 5: In FG24-4 and FG24-5, remove FFS before 3rd component.******Proposal 6: In FG 24-4 and FG 24-5, replace the sentence of “FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS” with the following agreement text as a separate component. “For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.”***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with set2 = (4, 3) and (7, 3) symbols where set2 is defined in FG3-5b 5. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.6. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)7. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b)  | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Perband | N/A | N/A | N/A | FFS: component description without a reference to other R15 FGs | Optional with capability signalling |

 |
| Vivo [3] | On 24-4/5 for 480/960KHz multi-PDSCH scheduling, it is not decided yet whether it is a separate FG or a component of 480/960 kHz support. In our view, there is no critical requirement for multi-PDSCH scheduling even when multi-slot PDCCH monitoring is used for 480/960 kHz. The only drawback is data rate loss brought by multi-slot PDCCH monitoring but the system still works. Therefore, separate optional multi-PDSCH scheduling capability is more flexible. In this way, to enhance data rate further, UE has flexibility to increase PDCCH monitoring complexity with smaller X value or support multi-PDSCH scheduling.Proposal 5: List multi-PDSCH scheduling by single DCI as a separate FG from 24-4 and 24-5. |
| OPPO [4] | In our view, multi-PDSCH scheduling by single DCI and the corresponding HARQ enhancements should be a mandatory component to support 480kHz DL transmission, the FFS for component 3 should be removed. On the other hand, according to the agreement marked in yellow below, the UE behavior of monitoring slots of Group (2) SS should be independent from that of monitoring slots of Group (1) SS, and should be a mandatory component to support 480kHz DL transmission. In addition, according to the agreement marked in cyan, only (Xs, Ys) = (4, 1) for 480kHz is mandatory and it should be clearly mentioned in component 4.***Agreement**** *For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS*
	+ *A SS is monitored within Y consecutive slots within a slot group of X slots*
	+ *The Y consecutive slots can be located anywhere within the slot group of X slots*
		- *Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0*
	+ *The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups*
	+ *BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots*
* *For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS*
	+ *SS monitoring locations can be anywhere within a slot group of X slots, with the following exception*
		- *BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if searchSpaceId = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.*
* *Supported combinations of (X,Y)*
	+ *A UE capable of multi-slot monitoring mandatorily supports*
		- *For SCS 480 kHz: (X,Y) = (4,1)*
		- *For SCS 960 kHz: (X,Y) = (8,1)*
	+ *A UE capable of multi-slot monitoring optionally supports*
		- *For SCS 480 kHz: (X,Y) = (4,2)*
		- *For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)*
			* *Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8*
* *A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots*
	+ *For Y>1: FG3-1 (**monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)*
	+ *For 960 kHz SCS For Y=1: FG3-5b with set1 = (7, 3)*
		- *[FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]*
	+ *For 480 kHz SCS For Y=1: FG3-5b with set2 = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot*
		- *[FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]*
	+ *The following supersedes FG3-5b and FG3-1 definition:*
	+ *Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD*
	+ *Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD*

**Proposal 5: for FG24-4,** * **removing “FFS” for component 3.**
* **removing “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” for component 4.**
* **adding a new component “7. Monitoring capability within a slot group of X slots of Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS”.**
* **replacing “Within the Ys = 1 slot” with “Within the Ys=1 slot (with Xs=4)” for component 4.**
 |
| ZTE/Sanechips [5] | * **Multi-PDSCH/PUSCH scheduling by single DCI**

For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, it seems that multi-PDSCH scheduling by single DCI can also be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI can be a component for FG 24-5a.However, although we know that the motivation of supporting multi-PDSCH/PUSCH scheduling by single DCI is to reduce signalling overhead, this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. With this consideration, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal 5: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG from FG 24-4, 24-4a, 24-5 and 24-5a**In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We suggest to further clarify the Group (2) SSs monitoring capability in the corresponding FG components. Specifically, “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” should be deleted and detailed descriptions of Group (2) SSs monitoring capability (marked in red) should be added in FG24-4, FG 24-4f, FG24-5 and FG24-5f. **Proposal 6: According the agreement made in RAN1 #107bis e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows (marked in red):**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Note |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements1. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with set2 = (4, 3) and (7, 3) symbols where set2 is defined in FG3-5b ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~

5. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.~~5~~6. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)~~6~~7. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b)  | FFS: component description without a reference to other R15 FGs |

 |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | For FG24-4, some FFSs remain there. Our view is as follows:* On whether to include component 3 (multi-PDSCH scheduling), we support to include it in this FG. It has been agreed already that multi-slot PDCCH monitoring with (Xs, Ys) = (4, 1) is also a component of this FG, which essentially needs multi-PDSCH scheduling in the practical operation.
* On monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS, there was an agreement that the same behaviour as in FG3-1 is supported. Since some FG3-1 components are not applicable for 480 kHz SCS operation even when FG24-4 is supported, we think it would be good to capture this explicitly.
* For the description refinement for component 4, we think the existing text for FG3-5b can be reused. Meanwhile, just to refer FG3-5b would also be ok for us.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)3. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot, where there is a minimum time separation of X symbols (including the cross-slot boundary case) between the start of two spans, where each span is of length up to Y consecutive OFDM symbols of a slot, with (X, Y) = (4, 3) and (7, 3) symbols. Spans do not overlap. Every span is contained in a single slot. The same span pattern repeats in every slot. The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans. Every monitoring occasion is fully contained in one span. In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value} except possibly the last span in a slot which can be of shorter duration. A particular PDCCH monitoring configuration meets the UE capability limitation if the span arrangement satisfies the gap separation for at least one (X, Y) in the UE reported candidate value set in every slot, including cross slot boundary. For type 1 CSS without dedicated RRC configuration, type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(S) of a slot. 5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b)  | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-4, there are two open issues. The first issues is to address the FFS on whether or not multi-PDSCH scheduling is a component of this FG, i.e., whether or not support of multi-PDSCH scheduling is mandatory in case the UE indicates support of FG 24-4. We have a strong preference that multi-PDSCH scheduling should be mandatory since it is mandatory that the UE supports multi-slot PDCCH monitoring (per slot group monitoring). Since the UE monitors less frequently for PDCCH, it is highly beneficial that the network is able to schedule multiple-PDSCHs with the same DCI, otherwise it will not be possible to sustain high throughput which is one of the main goals of operation in FR2-2. It makes little sense to relax the UE requirements on PDCCH monitoring and then hamstring the network by allowing only single-PDSCH scheduling. In our view, these two features go hand-in-hand and should not be split into different feature groups.The second issue is to address the FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). On this issue, the following agreement was made in RAN1#107bis-e which defines the mandatory capability:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We propose to include the wording of this agreement directly into the description of a new component for FG 24-4. We also propose revised wording of the other components to address the FFS on how to avoid making reference to other Rel-15 FGs.1. Modify FG 24-4 as follows such that Component 3 (multi-PDSCH scheduling) is mandatory for a UE that supports 480 kHz SCS in-line with the fact that per-slot group monitoring is mandatory for such a UE.
2. Modify FG2-4 as follows to add Component 5 for mandatory monitoring capability for Group (2) search spaces agreed in RAN1#107bis-e. In addition, revise the description of the other components to avoid the need to refer to other Rel-15 FGs.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)~~FFS:~~ 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where ~~set2~~ (X,Y) = (4, 3) and (7, 3) are supported ~~symbols where set2 is defined in FG3-5b~~ ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~5. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) within each slot of the slot group of Xs slots, with the monitoring occasions for any of type 1 CSS without dedicated RRC configuration, or type 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group of Xs slots.6~~5~~. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD ~~(This supersedes corresponding component of FG 3-5b)~~7~~6~~. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD ~~(This supersedes corresponding component of FG 3-5b)~~ | 24-1 | ~~FFS: component description without a reference to other R15 FGs~~ | Optional with capability signalling |

 |
| Apple [10] | 1. FG 24-4, incorporate agreement below into the component description to address (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS):

|  |
| --- |
| AgreementClarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
 |

1. Keep [3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements] in the component description
 |
| Samsung [11] |  |
| MediaTek Inc. [12] | We suggest to add separated FGs for the enhancements of both multi-PDSCH and multi-PUSCH scheduled by single DCI instead of including those FGs as basic FGs. We also suggest to add the notion of FR2-2 in this FG such that it can be differentiated from the existing multi-PUSCH feature introduced for Rel-16 NR-U and for FR2-1. Note that multi-PDSCH can’t be configured with legacy PDSCH repetition. Therefore, it is not desirable to include an enhanced feature as basic feature with the consequence of removing the legacy configuration.Proposal 6: Remove multi-PDSCH scheduling from FG24-4 and FG24-5 and add FGs for multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-4d | Multiple PDSCH scheduling by single DCI for 480 kHz in FR2-2 | 1. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | In [1], UE capability to support multi-PXSCH scheduling DCI is captured as a separate FG for 120 kHz and as a component of basic DL/UL FGs for 480 or 960 kHz SCS (with FFS for DL). In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to frequency ranges other than FR2-2 (i.e., also for 15/30/60 kHz SCS). For 480 and 960 kHz SCS, it is preferred to confirm that multi-PXSCH scheduling DCI is defined as a component of corresponding basic DL/UL FGs.**Proposal #2: Update FGs 24-4, as follows.**

|  |  |  |  |
| --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)3. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with set2 = (4, 3) and (7, 3) symbols where set2 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1a, 24-4 | Yes | N/A | 480KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] | * **Multi-PDSCH/PUSCH scheduling by single DCI**

For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, it seems that multi-PDSCH scheduling by single DCI can also be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI can be a component for FG 24-5a.However, although we know that the motivation of supporting multi-PDSCH/PUSCH scheduling by single DCI is to reduce signalling overhead, this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. With this consideration, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal 5: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG from FG 24-4, 24-4a, 24-5 and 24-5a** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] | Proposal 7: Remove multi-PUSCH scheduling from FG24-4a and FG24-5a and add FGs for multi-PUSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-4e | Multiple PUSCH scheduling by single DCI for 480 kHz in FR2-2 | 1. Multi- PUSCH scheduling by single DCI for the operation with 480 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | [Note: This FG is only supported in bands for shared spectrum operation] | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, there were discussion and no consensus on whether the FG24-1b and FG24-4b should be restricted in unlicensed band. Although the scope of WID [2] might not be crystal clear depending on different interpretation from companies, the main motivation to introduce longer PRACH sequence in RAN1 is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other hand, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So we propose to remove the bracket on the sentence of “[Note: This FG is only supported in bands for shared spectrum operation]” in the note column for FG24-1b and FG24-4b. There was discussion on whether FG24-1b should be supported if UE report the capability of FG24-2 (120KHz SSB support for initial access in FR2-2). To our understanding, it is not necessary because all basic uplink capabilities to fulfil the initial access procedures have been captured in FG24-1a, which is already the prerequisite of 24-2. Moreover, FG24-2 is applied for both licensed band unlicensed band while FG24-1b is only for unlicensed band from our perspective. The sentence of “[A UE that supports FG 24-2 must indicate this FG is supported]” should be deleted from the note column of FG24-1b.***Proposal 1: Remove the bracket on the sentence of “[Note: This FG is only supported in bands for shared spectrum operation]” in the note column for FG24-1b and FG24-4b***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | Note: This FG is only supported in bands for shared spectrum operation | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] | For FG 24-1b, the remaining issues are whether Wideband PRACH is mandatory for FR2-2 UL and whether it is only applied for the unlicensed band. For the former, we think that wideband PRACH can bring better performance, especially for coverage. So propose this FG as a mandatory feature for FR2-2 UL, that is, support removing yellow highlight and brackets of “[A UE that supports FG 24-2 must indicate this FG is supported]”. If it is agreed, we suggest to merge FG 24-1b into FG 24-1a. However, for the second issue, according to the revised WID, we can observe that wideband PRACH is not limited to operation with shared spectrum. The revised WID objective is as follows:

|  |
| --- |
| * Physical layer aspects including [RAN1]:
	+ Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
 |

“operation in shared spectrum” mentioned in the above objective is just to apply to RO configuration for non-consecutive RACH occasions (RO) in time domain, not for PRACH sequence lengths. Consequently, the PRACH sequence lengths part of this objective applies to both operation with/without shared spectrum. With this consideration, we propose to remove wording “[Note: This FG is only supported in bands for shared spectrum operation]” .Note that the same method used for 120kHz PRACH SCS can be applied to 480 kHz PRACH SCS(FG 24-4b).**Proposal 2: Modify FG 24-4b as follows:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | Optional with capability signalling |

**Proposal 3: Propose to merge FG 24-4b into FG 24-4a , as follows:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 139/5712. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1a, 24-4 | Yes | N/A | 480KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| ~~24-4b~~ | ~~Wideband PRACH for 480 kHz in FR2-2~~ | ~~PRACH with 480KHz and length 571~~ | ~~24-4a~~ | ~~Yes~~ | ~~N/A~~ | ~~Wideband PRACH for 480 kHz in FR2-2 is not supported~~ | ~~Per band~~ | ~~N/A~~ | ~~N/A~~ | ~~N/A~~ | ~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | ~~Optional with capability signalling~~ |

 |
| Nokia/Nokia Shanghai Bell [6] | * + It is fine to allow the usage in licensed spectrum if and only if there are no design changes. This would be still conforming with the intention of the WID.
 |
| NTT DOCOMO, INC. [7] | FG24-4b has a similar FFS to FG24-1b (i.e. whether to limit the applicable case within bands for shared spectrum operation). We believe the same handling as for FG24-1b should be applied anyway. We are ok with limiting the applicable case to unlicensed band only.  |
| Intel Corporation [8] | For UE operating with unlicensed SA mode, it needs to also support wideband PUCCH and wideband PRACH together. The main reason is that the wideband PUCCH and wideband PRACH were specifically targeted to improve the coverage issues due to power spectral density in unlicensed bands. However, if the UE optionally do not support this feature, this would shrink the potentially coverage for unlicensed cell deployments. Therefore, all UEs that is able to operate uplink transmission should support wideband PUCCH and wideband PRACH. Otherwise, the main motivation to introduce the feature is lost.Similarly for 480 kHz, we proposed the following:**Proposal 2:*** FG 24-4b and 24-4c add the note that “A UE that support FG24-3 must indicated this FG is supported”.
 |
| Ericsson [9] | Similar to FG 24-1b, our understanding of the WID is that FG 24-4b (wideband PRACH for 480 kHz SCS) is not restricted to shared spectrum operation only. 1. Modify FG 24-4b as follows such that wideband PRACH for 480 kHz is not restricted to shared spectrum operation only.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | ~~[Note: This FG is only supported in bands for shared spectrum operation]~~ | Optional with capability signalling |

 |
| Apple [10] | 1. Support removal of brackets around the statement [Note: This FG is only supported in bands for shared spectrum operation] based on WID
 |
| Samsung [11] | One remaining issue left for FG 24-1b (i.e., wideband PRACH for 120 kHz in FR2-2) is whether to mandate this FG when FG 24-2 is supported (i.e., 120 kHz SSB for initial access in FR2-2). It is true that supporting wideband PRACH can be beneficial in increasing the coverage of PRACH transmission, however, this feature may not be considered as mandatorily required for implementing initial access to the system, since FR2-1 only has PRACH with short sequence length as 139 and no significant coverage issue was found. Hence, we don’t support mandating this FG when FG 24-2 is supported. Another remaining issue left for FG 24-1b and 24-b (i.e., wideband PRACH for 120 kHz and 480 kHz in FR2-2, respectively) is whether to restrict these FGs for bands with shared spectrum operation only. This discussion originates from an unclear description of the working scope from the WID, and technically the benefit of wideband PRACH is from the PSD limitation on shared spectrum operation. It’s better to ask guidance from RAN plenary on the intention and working scope related to this issue, such that no time will be wasted in RAN1 discussion. **Proposal 1: For FG 24-1b and 24-4b:*** **Remove the note “A UE that supports FG 24-2 must indicate this FG is supported” for FG 24-1b.**
* **Ask guidance from RAN plenary on whether FG 24-1b and 24-4b are applicable other than shared spectrum operation.**
 |
| MediaTek Inc. [12] | Whether the FG 24-1b and FG 24-4b should be included as basic FR2-2 UL FGs was discussed in RAN1 #107-e meeting. Some company mentioned that PRACH is a fundamental channel in initial access and supporting such feature as basic functionality is necessary. However, the motivation of introducing such FG is to comply with regulation, which varies based on different regions. Therefore, we prefer to allow UE to have the option on whether to support the FG based on different regulations.Proposal 1: Modify FG 24-1b and FG24-4b as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571  |  | Optional with capability signalling[Note: This FG is only supported in bands for shared spectrum operation] |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | One of remaining issues for wideband PRACH is whether to support this feature only for shared spectrum operation or to support for both unlicensed and licensed band operation. In our view, wideband PRACH should be supported only for shared spectrum operation, since the motivation to introduce wideband PRACH in FR2-2 was to compensate coverage loss caused by power spectrum density restriction in regulatory requirement, similar to multi-RB PUCCH format 0/1/4.**Proposal #4: Update FGs 24-1b and 24-4b as follows.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | Wideband PRACH for 480 kHz in FR2-2 is not supported | Note: This FG is only supported in bands for shared spectrum operation |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 480 kHz | 24-4a | Yes | N/A | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] | For UE operating with unlicensed SA mode, it needs to also support wideband PUCCH and wideband PRACH together. The main reason is that the wideband PUCCH and wideband PRACH were specifically targeted to improve the coverage issues due to power spectral density in unlicensed bands. However, if the UE optionally do not support this feature, this would shrink the potentially coverage for unlicensed cell deployments. Therefore, all UEs that is able to operate uplink transmission should support wideband PUCCH and wideband PRACH. Otherwise, the main motivation to introduce the feature is lost.Similarly for 480 kHz, we proposed the following:**Proposal 2:**FG 24-4b and 24-4c add the note that “A UE that support FG24-3 must indicated this FG is supported”. |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal 3: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  | Optional with capability signallingThis FG is only supported in bands under PSD limitation in shared spectrum operation |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) | 24-4 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component for both FG24-4 and FG24-5.Following agreement on Group (2) SS monitoring for UE with multi slot PDCCH monitoring capability has been reached in RAN1#107bis-e. Thus, the sentence of “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” in FG24-4 and FG24-5 can be replaced with the yellow highlighted sentence in the agreement considering the guidance in the note column “FFS: component description without a reference to other R15 FGs”. **Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Further, if Group (2) SS monitoring capability is already described in FG24-4 and FG24-5, it does not need to be repeated in the corresponding advanced FG capabilities FG 24-4f and FG 24-5f. Therefore, we suggest to remove “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” from FG 24-4f and FG 24-5f.In RAN1#107e and RAN1#107bis-e, there is no consensus to introduce multi slot PDCCH monitoring capability with slot group of X=2 slots. Comparing with the already support capability of (Xs,Ys)=(4,2), the capability of (Xs,Ys)=(2,1) requires UE to at most monitor 4 occasions every 4 slots and every 2 monitoring occasions locate in the same slot. The UE complexity is increased significantly while the benefit is unclear. So we propose to change the component description back to “Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2)”.***Proposal 7: In FG 24-4f and FG 24-5f, remove “FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS”.******Proposal 8: In FG24-4f, component candidate value of (2,1) is not supported. The component 1 should be changed to support the optional capability with (Xs,Ys)=(4,2).***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)=(4,2)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot  | 24-4 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] | Since the UE behavior of monitoring slots of Group (2) SS is defined in FG24-4, the FFS for component 2 should be removed. Besides, according to the agreement above marked in cyan, (Xs, Ys) = (2, 1) should not be the candidate value for 480kHz and the note should be removed.**Proposal 6: for FG24-4f,** * **removing “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” for component 2.**
* **replacing “Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }” with “Component 1 candidate value: (4,2)”.**
* **removing “Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5”.**
 |
| ZTE/Sanechips [5] | In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We suggest to further clarify the Group (2) SSs monitoring capability in the corresponding FG components. Specifically, “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” should be deleted and detailed descriptions of Group (2) SSs monitoring capability (marked in red) should be added in FG24-4, FG 24-4f, FG24-5 and FG24-5f. **Proposal 6: According the agreement made in RAN1 #107bis e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows (marked in red):**

|  |  |  |  |
| --- | --- | --- | --- |
| 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~3.) For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5 |

 |
| Nokia/Nokia Shanghai Bell [6] | * + To follow corresponding definitions in 24-4, where appropriate.
 |
| NTT DOCOMO, INC. [7] | FG24-4f has a similar FFS to the 2nd point of FG24-4 above, that is, monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS. We believe it would be sufficient to follow FG24-4 according to the agreement at the last RAN1 e-meeting. If FG24-4 captures this point, FG24-4f doesn’t need to capture this since they are technically equivalent.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot  | 24-4 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5 | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | In our view there is no clear motivation for supporting per-slot group monitoring with (Xs,Ys) = (2,1). Some companies suggested that it could be beneficial for low latency applications; however, we note that the URLLC latency requirements can already be met with the slot duration corresponding to 120 kHz. Hence, there is no need to require the UE to monitor with a periodicity equal to half of this duration (2 slots at 480 kHz).There is also and FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). However, this is inherited from FG 24-4 which is a pre-requisite. Hence the FFS text can be removed.1. Modify FG 24-4f as follows to remove the capability related to (Xs,Ys) = (2,1). In addition, there is no need to include a component for the monitoring capability for Group (2) search spaces since this is inherited from FG 24-4 which is a pre-requisite.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~ | 24-4 | ~~Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }~~~~Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5~~ | Optional with capability signalling |

 |
| Apple [10] | 1. Still leave (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) until Group (2) SS design is done.
 |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)FFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with set1 = (7, 3) symbols where set1 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Perband | N/A | N/A | N/A | FFS: component description without a reference to other R15 FGs | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component for both FG24-4 and FG24-5.**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Following agreement on Group (2) SS monitoring for UE with multi slot PDCCH monitoring capability has been reached in RAN1#107bis-e. Thus, the sentence of “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” in FG24-4 and FG24-5 can be replaced with the yellow highlighted sentence in the agreement considering the guidance in the note column “FFS: component description without a reference to other R15 FGs”. Further, if Group (2) SS monitoring capability is already described in FG24-4 and FG24-5, it does not need to be repeated in the corresponding advanced FG capabilities FG 24-4f and FG 24-5f. Therefore, we suggest to remove “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” from FG 24-4f and FG 24-5f.In RAN1#107e and RAN1#107bis-e, there is no consensus to introduce multi slot PDCCH monitoring capability with slot group of X=2 slots. Comparing with the already support capability of (Xs,Ys)=(4,2), the capability of (Xs,Ys)=(2,1) requires UE to at most monitor 4 occasions every 4 slots and every 2 monitoring occasions locate in the same slot. The UE complexity is increased significantly while the benefit is unclear. So we propose to change the component description back to “Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2)”.***Proposal 5: In FG24-4 and FG24-5, remove FFS before 3rd component.******Proposal 6: In FG 24-4 and FG 24-5, replace the sentence of “FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS” with the following agreement text as a separate component. “For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.”***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with set1 = (7, 3) symbols where set1 is defined in FG3-5b 5. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.6. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)7. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Perband | N/A | N/A | N/A | FFS: component description without a reference to other R15 FGs | Optional with capability signalling |

 |
| Vivo [3] | On 24-4/5 for 480/960KHz multi-PDSCH scheduling, it is not decided yet whether it is a separate FG or a component of 480/960 kHz support. In our view, there is no critical requirement for multi-PDSCH scheduling even when multi-slot PDCCH monitoring is used for 480/960 kHz. The only drawback is data rate loss brought by multi-slot PDCCH monitoring but the system still works. Therefore, separate optional multi-PDSCH scheduling capability is more flexible. In this way, to enhance data rate further, UE has flexibility to increase PDCCH monitoring complexity with smaller X value or support multi-PDSCH scheduling.Proposal 5: List multi-PDSCH scheduling by single DCI as a separate FG from 24-4 and 24-5. |
| OPPO [4] | Similar as FG24-4, multi-PDSCH scheduling by single DCI and the corresponding HARQ enhancements should be a mandatory component to support 960kHz DL transmission, the FFS for component 3 should be removed. The UE behavior of monitoring slots of Group (2) SS should be independent from that of monitoring slots of Group (1) SS, and should be a mandatory component to support 960kHz DL transmission. In addition, only (Xs, Ys) = (8, 1) for 960kHz is mandatory and it should be clearly mentioned.**Proposal 7: for FG24-5,** * **removing “FFS” for component 3.**
* **removing “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)”.**
* **adding a new component “6. Monitoring capability within a slot group of X slots of Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS”.**
* **replacing “Within the Ys = 1 slot” with “Within the Ys=1 slot (with Xs=8)”.**
 |
| ZTE/Sanechips [5] | * **Multi-PDSCH/PUSCH scheduling by single DCI**

For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, it seems that multi-PDSCH scheduling by single DCI can also be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI can be a component for FG 24-5a.However, although we know that the motivation of supporting multi-PDSCH/PUSCH scheduling by single DCI is to reduce signalling overhead, this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. With this consideration, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal 5: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG from FG 24-4, 24-4a, 24-5 and 24-5a**In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We suggest to further clarify the Group (2) SSs monitoring capability in the corresponding FG components. Specifically, “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” should be deleted and detailed descriptions of Group (2) SSs monitoring capability (marked in red) should be added in FG24-4, FG 24-4f, FG24-5 and FG24-5f. **Proposal 6: According the agreement made in RAN1 #107bis e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows (marked in red):**

|  |  |  |  |
| --- | --- | --- | --- |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)FFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements1. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with set1 = (7, 3) symbols where set1 is defined in FG3-5b ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~

4. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.~~4~~5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)~~5~~6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) | FFS: component description without a reference to other R15 FGs |

 |
| Nokia/Nokia Shanghai Bell [6] | * + To follow corresponding definitions in 24-4, where appropriate.
 |
| NTT DOCOMO, INC. [7] | For FG24-5, similar to FG24-4, a few FFS points remain, and generally we have the same proposals:* On whether to include component 3 (multi-PDSCH scheduling), we support to include it in this FG. It has been agreed already that multi-slot PDCCH monitoring with (Xs, Ys) = (8, 1) is also a component of this FG, which essentially needs multi-PDSCH scheduling in the practical operation.
* On monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS, there was an agreement that the same behaviour as in FG3-1 is supported. Since some FG3-1 components are not applicable for 960 kHz SCS operation even when FG24-5 is supported, we think it would be good to capture this explicitly.
* For the description refinement for component 4, we think the existing text for FG3-5b can be reused.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, where there is a minimum time separation of X symbols (including the cross-slot boundary case) between the start of two spans, where each span is of length up to Y consecutive OFDM symbols of a slot, with (X, Y) = (7, 3) symbols. Spans do not overlap. Every span is contained in a single slot. The same span pattern repeats in every slot. The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans. Every monitoring occasion is fully contained in one span. In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value} except possibly the last span in a slot which can be of shorter duration. A particular PDCCH monitoring configuration meets the UE capability limitation if the span arrangement satisfies the gap separation for at least one (X, Y) in the UE reported candidate value set in every slot, including cross slot boundary. For type 1 CSS without dedicated RRC configuration, type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(S) of a slot. 4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Perband | N/A | N/A | N/A | FFS: component description without a reference to other R15 FGs | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | Similar to FG 24-4, there are two open issues. The first issues is to address the FFS on whether or not multi-PDSCH scheduling is a component of this FG, i.e., whether or not support of multi-PDSCH scheduling is mandatory in case the UE indicates support of FG 24-5. We have a strong preference that multi-PDSCH scheduling should be mandatory since it is mandatory that the UE supports multi-slot PDCCH monitoring (per slot group monitoring). Since the UE monitors less frequently for PDCCH, it is highly beneficial that the network is able to schedule multiple-PDSCHs with the same DCI, otherwise it will not be possible to sustain high throughput which is one of the main goals of operation in FR2-2. It makes little sense to relax the UE requirements on PDCCH monitoring and then hamstring the network by allowing only single-PDSCH scheduling. In our view, these two features go hand-in-hand and should not be split into different feature groups.The second issue is to address the FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). On this issue, the following agreement was made in RAN1#107bis-e which defines the mandatory capability:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We propose to include the wording of this agreement directly into the description of a new component for FG 24-5. We also propose revised wording of the other components to address the FFS on how to avoid making reference to other Rel-15 FGs.1. Modify FG 24-5 as follows such that Component 3 (multi-PDSCH scheduling) is mandatory for a UE that supports 960 kHz SCS in-line with the fact that per-slot group monitoring is mandatory for such a UE.
2. Modify FG2-5 as follows to add Component 5 for mandatory monitoring capability for Group (2) search spaces agreed in RAN1#107bis-e. In addition, revise the description of the other components to avoid the need to refer to other Rel-15 FGs.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)~~FFS:~~ 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4~~3~~. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with set1 = (7, 3) symbols where set1 is defined in FG3-5b ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~5. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) within each slot of the slot group of Xs slots, with the monitoring occasions for any of type 1 CSS without dedicated RRC configuration, or type 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group of Xs slots.6~~4~~. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD ~~(This supersedes corresponding component of FG 3-5b)~~7~~5~~. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD ~~(This supersedes corresponding component of FG 3-5b)~~ | 24-1 | ~~FFS: component description without a reference to other R15 FGs~~ | Optional with capability signalling |

 |
| Apple [10] | 1. FG 24-5, incorporate agreement below into the component description to address: (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)

|  |
| --- |
| AgreementClarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
 |

1. Keep [3. Multi- PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements] in the component description
 |
| Samsung [11] |  |
| MediaTek Inc. [12] | We suggest to add separated FGs for the enhancements of both multi-PDSCH and multi-PUSCH scheduled by single DCI instead of including those FGs as basic FGs. We also suggest to add the notion of FR2-2 in this FG such that it can be differentiated from the existing multi-PUSCH feature introduced for Rel-16 NR-U and for FR2-1. Note that multi-PDSCH can’t be configured with legacy PDSCH repetition. Therefore, it is not desirable to include an enhanced feature as basic feature with the consequence of removing the legacy configuration.Proposal 6: Remove multi-PDSCH scheduling from FG24-4 and FG24-5 and add FGs for multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-5d | Multiple PDSCH scheduling by single DCI for 960 kHz in FR2-2 | 1. Multi- PDSCH scheduling by single DCI for the operation with 960 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | In [1], UE capability to support multi-PXSCH scheduling DCI is captured as a separate FG for 120 kHz and as a component of basic DL/UL FGs for 480 or 960 kHz SCS (with FFS for DL). In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to frequency ranges other than FR2-2 (i.e., also for 15/30/60 kHz SCS). For 480 and 960 kHz SCS, it is preferred to confirm that multi-PXSCH scheduling DCI is defined as a component of corresponding basic DL/UL FGs.**Proposal #2: Update FGs 24-5, as follows.**

|  |  |  |  |
| --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with set1 = (7, 3) symbols where set1 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS] | 24-1a, 24-5 | Yes | N/A | 960KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] | Similar as FG24-4a, the component of “Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS” can be included in the FG of 960kHz SCS support for UL. We propose to remove the corresponding bracket.**Proposal 9: for FG24-5a,** * **removing bracket on “[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS]”.**
 |
| ZTE/Sanechips [5] | * **Multi-PDSCH/PUSCH scheduling by single DCI**

For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, it seems that multi-PDSCH scheduling by single DCI can also be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI can be a component for FG 24-5a.However, although we know that the motivation of supporting multi-PDSCH/PUSCH scheduling by single DCI is to reduce signalling overhead, this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. With this consideration, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal 5: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG from FG 24-4, 24-4a, 24-5 and 24-5a** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] | Similar to FG 24-4 and 24-5, the open issue is to address the FFS on whether or not multi-PUSCH scheduling is a component of this FG, i.e., whether or not support of multi-PUSCH scheduling is mandatory in case the UE indicates support of FG 24-5a. We have a strong preference that multi-PUSCH scheduling should be mandatory since it is mandatory that the UE supports multi-slot PDCCH monitoring (per slot group monitoring). Since the UE monitors less frequently for PDCCH, it is highly beneficial that the network is able to schedule multiple-PUSCHs with the same DCI, otherwise it will not be possible to sustain high throughput which is one of the main goals of operation in FR2-2. It makes little sense to relax the UE requirements on PDCCH monitoring and then hamstring the network by allowing only single-PUSCH scheduling. In our view, these two features go hand-in-hand and should not be split into different feature groups.1. Modify FG 24-5a as follows such that Component 3 (multi-PUSCH scheduling) is mandatory for a UE that supports 960 kHz SCS in-line with the fact that per-slot group monitoring is mandatory for such a UE.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-1a, 24-5 |  | Optional with capability signalling |

 |
| Apple [10] | 1. Keep [3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS] in the description similar to the conlusion from 24-4a {480KHz SCS support for UL}
 |
| Samsung [11] |  |
| MediaTek Inc. [12] | Proposal 7: Remove multi-PUSCH scheduling from FG24-4a and FG24-5a and add FGs for multi-PUSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-5e | Multiple PUSCH scheduling by single DCI for 960 kHz in FR2-2 | 1. Multi- PUSCH scheduling by single DCI for the operation with 960 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 960 kHz | 24-5a | Yes | N/A | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] |  |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] |  |
| Apple [10] |  |
| Samsung [11] |  |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal 3: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  | Optional with capability signallingThis FG is only supported in bands under PSD limitation in shared spectrum operation |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) | 24-5 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component for both FG24-4 and FG24-5.Following agreement on Group (2) SS monitoring for UE with multi slot PDCCH monitoring capability has been reached in RAN1#107bis-e. Thus, the sentence of “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” in FG24-4 and FG24-5 can be replaced with the yellow highlighted sentence in the agreement considering the guidance in the note column “FFS: component description without a reference to other R15 FGs”. **Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Further, if Group (2) SS monitoring capability is already described in FG24-4 and FG24-5, it does not need to be repeated in the corresponding advanced FG capabilities FG 24-4f and FG 24-5f. Therefore, we suggest to remove “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” from FG 24-4f and FG 24-5f.In RAN1#107e and RAN1#107bis-e, there is no consensus to introduce multi slot PDCCH monitoring capability with slot group of X=2 slots. Comparing with the already support capability of (Xs,Ys)=(4,2), the capability of (Xs,Ys)=(2,1) requires UE to at most monitor 4 occasions every 4 slots and every 2 monitoring occasions locate in the same slot. The UE complexity is increased significantly while the benefit is unclear. So we propose to change the component description back to “Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2)”.***Proposal 7: In FG 24-4f and FG 24-5f, remove “FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS”.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5f | Enhanced PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot  | 24-5 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] | Similar as FG24-4f, since the UE behavior of monitoring slots of Group (2) SS is defined in FG24-5, the FFS for component 2 should be removed. Besides, (Xs, Ys) = (4, 1) is optionally supported for 960kHz, so “Within each of the Ys = 2 or 4 slots” for component 2 should be replaced with “Within each of the Ys = 1, 2 or 4 slots”. **Proposal 8: for FG24-5f,** * **removing “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” for component 2.**
* **replacing “Within each of the Ys = 2 or 4 slots” with “Within each of the Ys = 1, 2 or 4 slots”.**
 |
| ZTE/Sanechips [5] | In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

We suggest to further clarify the Group (2) SSs monitoring capability in the corresponding FG components. Specifically, “(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)” should be deleted and detailed descriptions of Group (2) SSs monitoring capability (marked in red) should be added in FG24-4, FG 24-4f, FG24-5 and FG24-5f. **Proposal 6: According the agreement made in RAN1 #107bis e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows (marked in red):**

|  |  |  |  |
| --- | --- | --- | --- |
| 24-5f | Enhanced PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~3.) For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} |

 |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | FG24-5f has the same issue as in FG24-4f, so it would be straightforward to follow the direction to be taken for FG24-4f.

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|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot  | 24-5 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-5f, there is an FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). One could argue that this is inherited from FG 24-5 which is a pre-requisite; however, in FG 24-5 the slot groups size Xs is always 8, whereas for FG 24-5f, the slot group size can be 4. Hence, we suggest creating a new component copying the wording from the following agreement from RAN1#107bis-e:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.
1. Modify FG2-5f as follows to add Component 3 for mandatory monitoring capability for Group (2) search spaces agreed in RAN1#107bis-e.

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| 24-5f | Enhanced PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~3. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) within each slot of the slot group of Xs slots, with the monitoring occasions for any of type 1 CSS without dedicated RRC configuration, or type 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group of Xs slots. | 24-5 | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |

 |
| Apple [10] | 1. Still leave (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) until Group (2) SS design is done.
 |
| Samsung [11] |  |
| MediaTek Inc. [12] | There is a inconsistence between FG24-4f and FG24-5f on the FG naming where FR2-2 notion is missing in FG24-5f. We suggest to add such notion to align with FG24-4f. Proposal 2: Update FG 24-5f as follows:

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|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz in FR2-2 | ~~1.) Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(4,1)~~ ~~2.) Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)= (4,2)~~1.) Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)~~=(8,4) slots~~2.) Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot as in ~~according to~~ FG 3-1 (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure[2. Support LBT performed per carrier/BWP bandwidth] | 24-1a | Yes | N/A | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band |  |  |  | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In the AI8.2.6, the discussion on the LBT bandwidth is still ongoing. The controversial issue focuses on whether the LBT bandwidth should be equal to the active BWP or the channel bandwidth including the active BWP. In TS37.213, the terminology of “channel” is used and defined as “A channel refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum.” It is extended from “carrier” in early LTE LAA because NR-U allows carrier bandwidth larger than 20MHz which is mandated by regulation for LBT bandwidth. Although a channel in 37.213 is described as a set of contiguous RB, it does not imply the LBT can be implemented with the granularity of RB because LBT is usually performed in time domain due to short response time and a sensing slot (9us in FR1) is not aligned with OFDM symbol. Thus, it is further clarified in TS38.214 and TS38.101-1 that the RB set corresponds to 20MHz LBT bandwidth required by regulation. Similarly in FR2-2, considering the sensing slot (5us) is not aligned with OFDM symbol, defining LBT bandwidth exactly equal to active BWP is hardly implementable even if there is no regulatory requirement on LBT bandwidth. Moreover, it is not cost efficient to support various LBT bandwidths according to every configurable active BWP. So we propose to update “per carrier/BWP” as “per channel including active BWP” in the component of 24-6 and 24-7.***Proposal 9: Update “per carrier/BWP” as “per channel including active BWP” in the component of 24-6 and 24-7.***

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|  | 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure2. Support LBT performed per channel including active BWP bandwidth | 24-1a | Yes | N/A | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] | Regarding LBT bandwidth, from RAN1 point of view, it seems to correspond to BWP bandwidth due to RAN1 has no the term “channel/carrier bandwidth”. However, the detail on the definition of LBT bandwidth is still under discussion in agenda item 8.2.6 and no consensus. In this regard, we propose to update component 2 here after the relevant conclusions are made.**Proposal 7:** **Component 2 of FG24-6 and FG 24-7 can be updated after the relevant conclusions on the definition of LBT bandwidth are made.** |
| Nokia/Nokia Shanghai Bell [6] | * + To follow corresponding definitions in 24-4, where appropriate.
 |
| NTT DOCOMO, INC. [7] | For FG24-6 and FG24-7, an explicit description on LBT bandwidth may be captured, while the exact text is still FFS. In our understanding, we need to wait for WI progress a bit more, if needed, since there is an on-going discussion under AI 8.2.6.  |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-6 and FG 24-7, there is an FFS on Component 2 on the LBT bandwidth, due to the fact that the discussion has not yet concluded in Agenda Item 8.2.6 (Channel Access). 1. Support Type 2 channel access procedure[2. Support LBT performed per carrier/BWP bandwidth]Based on this, we suggest to leave the square brackets in place until this discussion in AI 8.2.6 concludes.1. For FG 24-6 and FG 24-7, wait until the discussion in Agenda Item 8.2.6 (Channel Access) concludes before resolving the square brackets on Component 2.
 |
| Apple [10] | 1. In the FG 24-6 and 24-7 components, we can remove the brackets around “[Support LBT performed per carrier/BWP bandwidth]” based on the following agreement:

*Agreement:**For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)*Note that to make it match the agreement, we could modify the text as follows: “[Support LBT performed per carrier [ ~~/~~ ] or BWP bandwidth]” |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure[2. Support LBT performed per carrier/BWP bandwidth] | 24-1a, 24-6 | Yes | N/A | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In the AI8.2.6, the discussion on the LBT bandwidth is still ongoing. The controversial issue focuses on whether the LBT bandwidth should be equal to the active BWP or the channel bandwidth including the active BWP. In TS37.213, the terminology of “channel” is used and defined as “A channel refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum.” It is extended from “carrier” in early LTE LAA because NR-U allows carrier bandwidth larger than 20MHz which is mandated by regulation for LBT bandwidth. Although a channel in 37.213 is described as a set of contiguous RB, it does not imply the LBT can be implemented with the granularity of RB because LBT is usually performed in time domain due to short response time and a sensing slot (9us in FR1) is not aligned with OFDM symbol. Thus, it is further clarified in TS38.214 and TS38.101-1 that the RB set corresponds to 20MHz LBT bandwidth required by regulation. Similarly in FR2-2, considering the sensing slot (5us) is not aligned with OFDM symbol, defining LBT bandwidth exactly equal to active BWP is hardly implementable even if there is no regulatory requirement on LBT bandwidth. Moreover, it is not cost efficient to support various LBT bandwidths according to every configurable active BWP. So we propose to update “per carrier/BWP” as “per channel including active BWP” in the component of 24-6 and 24-7.***Proposal 9: Update “per carrier/BWP” as “per channel including active BWP” in the component of 24-6 and 24-7.***

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|  | 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure2. Support LBT performed per channel including active BWP bandwidth | 24-1a, 24-6 | Yes | N/A | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] | Regarding LBT bandwidth, from RAN1 point of view, it seems to correspond to BWP bandwidth due to RAN1 has no the term “channel/carrier bandwidth”. However, the detail on the definition of LBT bandwidth is still under discussion in agenda item 8.2.6 and no consensus. In this regard, we propose to update component 2 here after the relevant conclusions are made.**Proposal 7:** **Component 2 of FG24-6 and FG 24-7 can be updated after the relevant conclusions on the definition of LBT bandwidth are made.** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | For FG24-6 and FG24-7, an explicit description on LBT bandwidth may be captured, while the exact text is still FFS. In our understanding, we need to wait for WI progress a bit more, if needed, since there is an on-going discussion under AI 8.2.6.  |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-6 and FG 24-7, there is an FFS on Component 2 on the LBT bandwidth, due to the fact that the discussion has not yet concluded in Agenda Item 8.2.6 (Channel Access). 1. Support Type 2 channel access procedure[2. Support LBT performed per carrier/BWP bandwidth]Based on this, we suggest to leave the square brackets in place until this discussion in AI 8.2.6 concludes.1. For FG 24-6 and FG 24-7, wait until the discussion in Agenda Item 8.2.6 (Channel Access) concludes before resolving the square brackets on Component 2.
 |
| Apple [10] | 1. In the FG 24-6 and 24-7 components, we can remove the brackets around “[Support LBT performed per carrier/BWP bandwidth]” based on the following agreement:

*Agreement:**For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)*Note that to make it match the agreement, we could modify the text as follows: “[Support LBT performed per carrier [ ~~/~~ ] or BWP bandwidth]” |
| Samsung [11] |  |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

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| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, the following agreement is achieved on the support of 32 HARQ processes for 120kHz SCS. Considering UE will or will not support 32 HARQ processes for all supported SCS in FR2-2, it is not necessary to differentiate the FG from numerologies. Therefore, we propose to at least remove the text “for 480/960 kHz” in the component description in FG24-8 and FG24-9. **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.

The support of 32 HARQ processes was also introduced in NTN WI (FG26-5) for NTN cell in FR1 and FR2-1. It is under discussion under NTN UE feature whether such capability can be extended to other non-NTN cell. The answer should obviously be yes since it was also agreed to support 32 HARQ processes for FR2-2 as part of this WI. Moreover, if the support of multiple PDSCH/PUSCH scheduling by single DCI is extended to bands outside of FR2-2, as in NRU Rel-16, the support of 32 HARQ processes should be extended together to avoid HARQ processing starvation. So we think the FG26-5 discussed in NTN WI can be applied to all numerologies in both FR1 and FR2. The FG24-8 and FG24-9 are overlapping with FG26-5. ***Proposal 10: Remove “for 480/960kHz” in the component of FG24-8 and FG24-9.******Observation 1: FG24-8 and FG24-9 are overlapping with FG26-5 (Increasing the number of HARQ processes) discussed in NTN WI. If FG26-5 were reported “per band” and defined independently of the numerologies and the feature (i.e. not limited to NTN or 60 GHz, etc.), FG24-8 and FG24-9 could be removed.***

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|  | 24-8 | 32 DL HARQ processes [for FR 2-2] | Support 32 HARQ processes in DL  |  |  |  |  | per band | N/A | N/A | N/A | FFS: extend to other FRs | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] | In RAN1 #107b-emeeting, the following agreement was achieved:***Agreement**** *In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.*

Therefore, a new FG should be introduced to define the capability of supporting 32 HARQ processes. If introduced, this FG should be supported per FSPC. **Proposal 11: introducing a new FG to define the capability of supporting 32 HARQ processes.**  |
| ZTE/Sanechips [5] | In RAN1 #107bis e-meeting, the following agreement was made in agenda item 8.2.5, which means 32 HARQ processes in DL/UL for 120kHz is supported depends on whether a UE has capability to support 32 DL/UL HARQ processes in DL/UL for 480/960 kHz. For this, we propose to add a new feature on 32 HARQ processes in DL/UL for 120 kHz and it is a prerequisite of FG 24-8/9.

|  |
| --- |
| **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

Besides, according to the following agreement, it had supported 32 as the maximum number of HARQ process for Rel-17 NTN and NR FR2-2 at least for 480/960 kHz SCS. However, NTN only introduces the UE feature for FR1. Therefore, it is necessary to support a separate FG 24-8 and 24-9 in FR2-2. If this feature is extended to FR1 and/or FR2-1, then it can be defined as per UE.Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.

Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.**Proposal 8:** **Propose adding new Feature to support 32 HARQ processes in DL/UL for 120kHz and as prerequisite of FG 24-8/9.****Proposal 9:** **If this feature can be extended to FR1 and FR2-1, it can be defined as per UE.** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | FG24-8 and 24-9 define the capabilities for the support of 32 HARQ processes. RAN1 reached the following agreement at the last RAN1 e-meeting.

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| --- |
| **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

The agreement above can be interpreted by itself such that 1) we have to define another FG on the support of 32 HARQ processes for 120 kHz SCS, and 2) the new capability is defined as a prerequisite of FG24-8 and 24-9. However, considering the discussion so far, we are not sure if we should define such separate FG for 120 kHz SCS. 32 HARQ processes in FR2-2 is motivated based on the fact that larger number of symbols are defined for some processing related timeline parameters for larger SCSs, which potentially leads to HARQ process number starvation. In other words, we do not see it technically necessary to support 32 HARQ processes for 120 kHz SCS. Rather, we understand the intention of the agreement above to aim for an unified PHY design across the supported SCSs. Given above, we are not sure if 32 HARQ processes support deserves a separate FG. Instead, we propose to delete all the SCS-related texts in FG24-8 and 24-9. There is another important discussion on this issue – whether this FG is merged with other FG from other WI. In NR NTN WI, the same mechanism was agreed and there are corresponding FGs as FG26-5. In addition, it seems that the discussion includes another big issue behind, which is whether maximum of 32 HARQ processes can be applied to cell other than NTN/FR2-2. In short, our view is that the feature should not be applicable for other cases and correspondingly there is no need to merge the FGs. From the applicability perspective, there are two rationales:* No agreements in any WIs. The 32 HARQ processes feature was agreed in NTN WI and FR2-2 WI for these purposes, but not for other purposes. Without certain agreements at appropriate WG or TEI, such an expansion should not be allowed.
* UE burden or signaling overhead. If this feature is applicable for any cell/band and corresponding FG is per UE, then UE that would like to indicate “support” shall support this feature for any cell/band. In our view, there is motivation of this FG only for NTN/FR2-2, so the excessive support is not preferable. Alternatively if this feature is applicable for any cell/band and corresponding FG is per band, then UE needs to report support/not support for all the bands that UE supports including bands without any motivation of this feature, which is meaningless overhead.

Also, as FG24-8 and FG24-9, there is still an issue specific to FR2-2. If we are to merge it with the one in NR NTN WI, such WI-specific issues may need to be considered even in other WIs. We assume such direction just makes the discussion much more complex, and no clear need to do so is observed at this stage. Given above, we suggest the following update for NR 52.6 – 71 GHz feature list:**Proposal 2:** FG24-8 and 24-9 are not merged with FG26-5 defined in NR NTN

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| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL | 24-1 |  |  |  | [Per UE/per FSPC/per band] |  |  |  |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-8 and FG 24-9, there is an FFS on whether or not these features are supported for 120 kHz. We note that the following agreement was made in RAN1#107bis-e, hence the note with FFS on 120 kHz can be removed and the component description can be made agnostic to subcarrier spacing.**Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.

While it is apparent that a UE that supports 32 HARQ processes should have that capability regardless of the band number, we are fine with capability signalling per-band instead of per-UE. We understand that some UE vendors prefer to re-rest features as new bands are added, hence it can be beneficial to have per-band capability signalling to facilitate such IODT testing on a phased basis.1. Modify FG 24-8 and FG 24-9 as follows to clarify that (1) these FGs are agnostic to SCS, and (2) the capability signalling is per band.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL ~~for 480/960 kHz~~ | 32 HARQ processes in the DL is not supported | ~~[Per UE/per FSPC/~~per band~~]~~ | ~~FFS: 120 kHz~~ | Optional with capability signalling |

 |
| Apple [10] | 1. FG 24-8: the signaling is per band but is only expected for a band where shared spectrum channel access must be used (similar to FG 10-1 for NR-U in 38.822).
 |
| Samsung [11] | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, the supporting of FG 24-8 and 24-9 should be per FSPC, such that UE has a better control when implementation this feature. **Proposal 4: For FG 24-8 and FG 24-9:*** **Keep the FGs separately from supporting 32 HARQ processes in NTN;**
* **“Type” of the FGs are per FSPC.**
 |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | For FGs 24-8 and 24-9, there is one FFS point regarding whether to support 32 DL/UL HARQ processes for 120 kHz SCS based on the following agreement.

|  |
| --- |
| Agreement: (RAN1#106bis-e)For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.
 |

Additionally, the following agreement was made in RAN1#107bis-e.

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| --- |
| **Agreement** (RAN1#107bis-e)* In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

Therefore, FGs 24-8 and 24-9 should be updated according to the above agreement such that a UE capable of 32 HARQ processes in FR2-2 supports this feature for all SCSs in FR2-2.**Proposal #3: According to the agreement made in RAN1#107bis-e, update FGs 24-8 and 24-9 as follows.**

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| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz |  |

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| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, the following agreement is achieved on the support of 32 HARQ processes for 120kHz SCS. Considering UE will or will not support 32 HARQ processes for all supported SCS in FR2-2, it is not necessary to differentiate the FG from numerologies. Therefore, we propose to at least remove the text “for 480/960 kHz” in the component description in FG24-8 and FG24-9. **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.

The support of 32 HARQ processes was also introduced in NTN WI (FG26-5) for NTN cell in FR1 and FR2-1. It is under discussion under NTN UE feature whether such capability can be extended to other non-NTN cell. The answer should obviously be yes since it was also agreed to support 32 HARQ processes for FR2-2 as part of this WI. Moreover, if the support of multiple PDSCH/PUSCH scheduling by single DCI is extended to bands outside of FR2-2, as in NRU Rel-16, the support of 32 HARQ processes should be extended together to avoid HARQ processing starvation. So we think the FG26-5 discussed in NTN WI can be applied to all numerologies in both FR1 and FR2. The FG24-8 and FG24-9 are overlapping with FG26-5. ***Proposal 10: Remove “for 480/960kHz” in the component of FG24-8 and FG24-9.******Observation 1: FG24-8 and FG24-9 are overlapping with FG26-5 (Increasing the number of HARQ processes) discussed in NTN WI. If FG26-5 were reported “per band” and defined independently of the numerologies and the feature (i.e. not limited to NTN or 60 GHz, etc.), FG24-8 and FG24-9 could be removed.***

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|  | 24-9 | 32 UL HARQ processes [for FR 2-2] | Support 32 HARQ processes in UL  |  |  |  |  | per band | N/A | N/A | N/A | FFS: extend to other FRs | Optional with capability signalling |

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| Vivo [3] |  |
| OPPO [4] | In RAN1 #107b-emeeting, the following agreement was achieved:***Agreement**** *In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.*

Therefore, a new FG should be introduced to define the capability of supporting 32 HARQ processes. If introduced, this FG should be supported per FSPC. **Proposal 11: introducing a new FG to define the capability of supporting 32 HARQ processes.**  |
| ZTE/Sanechips [5] | In RAN1 #107bis e-meeting, the following agreement was made in agenda item 8.2.5, which means 32 HARQ processes in DL/UL for 120kHz is supported depends on whether a UE has capability to support 32 DL/UL HARQ processes in DL/UL for 480/960 kHz. For this, we propose to add a new feature on 32 HARQ processes in DL/UL for 120 kHz and it is a prerequisite of FG 24-8/9.

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| **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

Besides, according to the following agreement, it had supported 32 as the maximum number of HARQ process for Rel-17 NTN and NR FR2-2 at least for 480/960 kHz SCS. However, NTN only introduces the UE feature for FR1. Therefore, it is necessary to support a separate FG 24-8 and 24-9 in FR2-2. If this feature is extended to FR1 and/or FR2-1, then it can be defined as per UE.Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.

Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.**Proposal 8:** **Propose adding new Feature to support 32 HARQ processes in DL/UL for 120kHz and as prerequisite of FG 24-8/9.****Proposal 9:** **If this feature can be extended to FR1 and FR2-1, it can be defined as per UE.** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | FG24-8 and 24-9 define the capabilities for the support of 32 HARQ processes. RAN1 reached the following agreement at the last RAN1 e-meeting.

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| **Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

The agreement above can be interpreted by itself such that 1) we have to define another FG on the support of 32 HARQ processes for 120 kHz SCS, and 2) the new capability is defined as a prerequisite of FG24-8 and 24-9. However, considering the discussion so far, we are not sure if we should define such separate FG for 120 kHz SCS. 32 HARQ processes in FR2-2 is motivated based on the fact that larger number of symbols are defined for some processing related timeline parameters for larger SCSs, which potentially leads to HARQ process number starvation. In other words, we do not see it technically necessary to support 32 HARQ processes for 120 kHz SCS. Rather, we understand the intention of the agreement above to aim for an unified PHY design across the supported SCSs. Given above, we are not sure if 32 HARQ processes support deserves a separate FG. Instead, we propose to delete all the SCS-related texts in FG24-8 and 24-9. There is another important discussion on this issue – whether this FG is merged with other FG from other WI. In NR NTN WI, the same mechanism was agreed and there are corresponding FGs as FG26-5. In addition, it seems that the discussion includes another big issue behind, which is whether maximum of 32 HARQ processes can be applied to cell other than NTN/FR2-2. In short, our view is that the feature should not be applicable for other cases and correspondingly there is no need to merge the FGs. From the applicability perspective, there are two rationales:* No agreements in any WIs. The 32 HARQ processes feature was agreed in NTN WI and FR2-2 WI for these purposes, but not for other purposes. Without certain agreements at appropriate WG or TEI, such an expansion should not be allowed.
* UE burden or signaling overhead. If this feature is applicable for any cell/band and corresponding FG is per UE, then UE that would like to indicate “support” shall support this feature for any cell/band. In our view, there is motivation of this FG only for NTN/FR2-2, so the excessive support is not preferable. Alternatively if this feature is applicable for any cell/band and corresponding FG is per band, then UE needs to report support/not support for all the bands that UE supports including bands without any motivation of this feature, which is meaningless overhead.

Also, as FG24-8 and FG24-9, there is still an issue specific to FR2-2. If we are to merge it with the one in NR NTN WI, such WI-specific issues may need to be considered even in other WIs. We assume such direction just makes the discussion much more complex, and no clear need to do so is observed at this stage. Given above, we suggest the following update for NR 52.6 – 71 GHz feature list:**Proposal 2:** FG24-8 and 24-9 are not merged with FG26-5 defined in NR NTN

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| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL | 24-1 |  |  |  | [Per UE/per FSPC/per band] |  |  |  |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | For FG 24-8 and FG 24-9, there is an FFS on whether or not these features are supported for 120 kHz. We note that the following agreement was made in RAN1#107bis-e, hence the note with FFS on 120 kHz can be removed and the component description can be made agnostic to subcarrier spacing.**Agreement*** In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.

While it is apparent that a UE that supports 32 HARQ processes should have that capability regardless of the band number, we are fine with capability signalling per-band instead of per-UE. We understand that some UE vendors prefer to re-rest features as new bands are added, hence it can be beneficial to have per-band capability signalling to facilitate such IODT testing on a phased basis.1. Modify FG 24-8 and FG 24-9 as follows to clarify that (1) these FGs are agnostic to SCS, and (2) the capability signalling is per band.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL ~~for 480/960 kHz~~ | 32 HARQ processes in the UL is not supported | ~~[Per UE/per FSPC/~~per band~~]~~ | ~~FFS: 120 kHz~~ | Optional with capability signalling |

 |
| Apple [10] | 1. FG 24-9: the signaling is per band but is only expected for a band where shared spectrum channel access must be used (similar to FG 10-1 for NR-U in 38.822)
 |
| Samsung [11] | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, the supporting of FG 24-8 and 24-9 should be per FSPC, such that UE has a better control when implementation this feature. **Proposal 4: For FG 24-8 and FG 24-9:*** **Keep the FGs separately from supporting 32 HARQ processes in NTN;**
* **“Type” of the FGs are per FSPC.**
 |
| MediaTek Inc. [12] |  |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | For FGs 24-8 and 24-9, there is one FFS point regarding whether to support 32 DL/UL HARQ processes for 120 kHz SCS based on the following agreement.

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| --- |
| Agreement: (RAN1#106bis-e)For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.
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Additionally, the following agreement was made in RAN1#107bis-e.

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| **Agreement** (RAN1#107bis-e)* In NR FR2-2, a UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL (or for UL) shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL (or UL), subject to UE capability.
 |

Therefore, FGs 24-8 and 24-9 should be updated according to the above agreement such that a UE capable of 32 HARQ processes in FR2-2 supports this feature for all SCSs in FR2-2.**Proposal #3: According to the agreement made in RAN1#107bis-e, update FGs 24-8 and 24-9 as follows.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS | Yes | N/A | [Additional beam switching time delay is not supported] | [Per UE/per band] | N/A | N/A | N/A | Yes | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | Following note was included in UE feature LS to RAN2 :

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| Note that in NR\_ext\_to\_71GHz, FG 24-10 “Additional beam switching time delay”, RAN1 is still discussing whether to define default values or whether UEs need to signal this FG is supported if one or more other FG is supported. |

In Rel-17, additional beam switching time delay was agreed to be specified as d=28 symbols for 120 kHz. Majority of companies were supportive of the idea of following the modus operandi in Rel-17 to support the same absolute time for the timeline related parameters in 120 kHz and 480 kHz and, as such, specify d=112 symbols for 480 kHz. However, some companies had a concern that d=112 would be excessively long and proposed to support d=56. As a compromise, RAN1 agreed to support a UE capability for this parameter with the candidate values of {56, 112}. Aligned with the practice throughout Rel-17, we think that the default value of d=112 should be supported for this FG so, in case that UE does not report this capability, the same timeline as in 120 kHz can be preserved. Additionally, if UE does not report this FG and there is no default value for it, gNB may assume d=0 for 480 kHz. This would certainly be a problematic assumption since d is specified to be a non-zero value for all other numerologies and is agreed to be either 56 or 112 for 480 kHz. We do not see any value in reporting this feature per band and we think that this should be reported per UE. Finally, there is a sentence “[Additional beam switching time delay is not supported]” in the column “Consequence if the feature is not supported by the UE” (this sentence is actually included in the LS in the neighboring column by mistake). We think this sentence is misleading as the additional beam switching time delay as always supported (its value cannot be zero). The only question is whether and how to define a default value for it.***Proposal 11: For FG24-10, support the default value of d=112.*** ***Proposal 12: For FG24-10, support “Per UE” report.******Proposal 13: For FG24-10, remove “[Additional beam switching time delay is not supported]”.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS | Yes | N/A | [ |  | Per UE | N/A | N/A | Yes | Candidate value set: 56 or 112 symbolsThe default value of 112 symbols is assumed if this capability is not reported | Optional with capability signalling |

 |
| Vivo [3] |  |
| OPPO [4] | Regarding this FG, “per band” is preferred. In our view, UE may optionally report 56 symbols or 112 symbols for this FG. On the other hand, we prefer to add 480kHz SCS in the description to make it clearer. **Proposal 10: for FG24-10,** * **supporting “per band”.**
* **replacing “[Additional beam switching time delay is not supported]” with “Additional beam switching time delay is not supported for 480kHz SCS”.**
 |
| ZTE/Sanechips [5] | In RAN1#107bis-e meeting, the following agreement on FG 24-10 related to additional beam switching time delay *d* is reached. In case where the triggering PDCCH and the triggered AP-CSI-RS have different SCSs, additional delay *d* is applied when µPDCCH < µCSIRS. With additional delay *d*, the total beam switch threshold for AP-CSI-RS equals to *beamSwitchTiming* + *d .* In fact, for additional delay *d* of 15/30/60kHz and 120kHz, we have not introduced any UE capabilities. For additional delay *d* of 480kHz, we introduce an UE capability signaling which indicates 56 symbols or 112 symbols. **Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  | Yes | N/A | [Additional beam switching time delay is not supported] | [Per UE/per band] | N/A | N/A | N/A | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

Note: continue discussion on whether to define default values or whether UEs need to signal this FG is supported if one or more other FG is supported One remaining issue is that whether to define a default value or whether an UE needs to signal the FG of additional *d* is supported if one or more other FG is supported. If the UE only supports 112 symbols, we don't think it is necessary to force the UE to report its capability. We propose additional delay *d* = 112 symbols as the basic UE capability and *d* = 56 symbols as the optional UE capability. If the UE does not report its capability, *d* = 112 symbols can be used as default UE capability. In addition, we prefer to have FG 24-10 with “per band”.**Proposal 10: Propose that additional beam switching time delay *d* = 112 symbols as the basic UE capability and *d* = 56 symbols as the optional UE capability. Modify FG 24-10 as follows.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  | Yes | N/A | ~~[~~Additional beam switching time delay d = 56 symbols is not supported~~]~~ | ~~[Per UE/~~per band~~]~~ | N/A | N/A | N/A | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] |  |
| Intel Corporation [8] |  |
| Ericsson [9] | The following agreement was made in RAN1#106bis-e:Agreement:For additional beam switching time delay d of 480 kHz, introduce UE capability signalling which indicates 56 symbols or 112 symbols.The intention with this agreement is that the UE should indicate capability for either 56 or 112 symbols to support cross-carrier scheduling/ap-CSI-RS triggering from 480 kHz to 960 kHz SCS. Indeed, the following is specified in 38.214 Section 5.2.1.5.1a. In this sense, FG 24-10 is not optional. Rather it is mandatory to report one of the values amongst {56,112} if the UE supports both 480 and 960 kHz SCS.Based on this, we propose the following. We also prefer signaling "per band" as with all other features in this WI.[38.214 Section 5.2.1.5.1a]For ***µPDCCH*** = 5, UE shall report one of values of {56, 112} for additional beam switching time delay *d*.**Table 5.2.1.5.1a-1: Additional beam switching timing delay *d***

|  |  |
| --- | --- |
| ***µPDCCH*** | ***d* [PDCCH symbols]** |
| 0 | 8 |
| 1 | 8 |
| 2 | 14 |
| 3 | 28 |
| 5 | {56, 112} |

1. Modify FG 24-10 as follows to capture that (1) if the UE supports 480 and 960 kHz SCS, then it is mandatory to support signalling of one of the candidate values {56, 112} symbols, and (2) the capability signalling is per band.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS | Yes | ~~[Additional beam switching time delay is not supported]~~ | ~~[Per UE/~~per band~~]~~ | Candidate value set: 56 or 112 symbolsA UE that supports both FG 24-4 and 24-5 must indicate this FG is supported | Optional with capability signalling |

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| Apple [10] | 1. For FG 24-10, make the ‘112' as default for all of UEs and ’56’ as optional (which originally introduced for some advanced UE in previous discussions).
 |
| Samsung [11] | For FG 24-10, one remaining issue left is how to understand the UE behavior when this FG is not reported. We want to note that this FG is the additional beam switching time delay for 480 kHz SCS, which is intended to relax the UE’s beam switching time delay. In this sense, a UE should always try to report a value in order to benefit its implementation, and hence, there should be no issue to mandate the UE to report a value from the candidate value set.Another remaining issue is the type of this FG, and we believe it should be “per band” to be consistent with other FGs for FR2-2. **Proposal 5: For FG 24-10:*** **A UE is mandated to report a value from the candidate value set;**
* **“Type” of the FG is per band.**
 |
| MediaTek Inc. [12] | For the additional beam switching time delay FG, there was a discussion on the UE behavior when UE doesn’t signal to support the FG. Based on our understanding, the FG is used to specify which additional beam switching time delay UE needs among d=56 and d=112, instead of whether UE needs additional beam switching time delay for 480kHz or not. Therefore, we prefer to have d=112 as default value if UE didn’t signal such capability.Proposal 4: Update FG24-10 as follows:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d=56 for 480 kHz SCS |  | Yes | N/A | Additional beam switching time delay d=112 is supported | Per UE | N/A | N/A | N/A | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] |  |

**Others**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| Vivo [3] |  |
| OPPO [4] |  |
| ZTE/Sanechips [5] | The revised WID notes the applicability of the UE features introduced for FR 2-2 should be discussed case by case. Note 5: FR2 is extended to cover 24.25GHz to 71GHz with FR2-1 for 24.25-52.6GHz and FR2-2 for 52.6-71GHz. * + The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analysed on a case by case basis
	+ The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.

Firstly, as described in second bullet in Note 5, we should consider application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) of any of the UE feature. In our opinion, at least we need to consider the possibility of extending the UE features newly introduced for 120KHz or all SCSs to FR2-1 even FR1, e.g. multi-PDSCH/PUSCH scheduling by a single DCI. In addition, since FR2-2 involve both licensed and unlicensed spectrum operation, the application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG should be discussed case by case.**Proposal 1: The application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) and application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG introduced for FR2-2 should be discussed case by case.**In RAN1 #107bis e-meeting, which FG can be regarded as a basic feature group was further discussed, but there is no significant progress and consensus. In our view, we think that basic FG can be determined based on one ot the following rule:Alt1: the determination of basic FG is related to a certain deploy scenario as shown in Table 1. The deployment scenarios for operation in FR2-2 are as following:1. Scenario A: CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
2. Scenario B-1: CA with PCell in FR1 (or FR2-1) + SCell (DL+UL) in FR2-2
3. Scenario B-2: DC with PCell in FR1 (or FR2-1) + PSCell (DL+UL) in FR2-2
4. Scenario C: Standalone operation in FR2-2, i.e., PCell in FR2-2

Table 1: The relationship between basic FGs and deployment scenarios

|  |  |
| --- | --- |
| Basic FGs | deployment scenarios |
| ASCell (DL-only) | B-1SCell (DL+UL) | B-2 (DC)PSCell (DL+UL) | C (Standalone) |
| 24-1: Basic FR2-2 DL support | √ | √ | √ | √ |
| 24-1a: Basic FR2-2 UL support (including Wideband PRACH) |  | √ | √ | √ |
| 24-1c: Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 |  | √(for unlicensed band) | √(for unlicensed band) | √(for unlicensed band) |
| 24-1d: Multiple PDSCH scheduling by single DCI for 120kHz |  |  |  |  |
| 24-1e: Multiple PUSCH scheduling by single DCI for 120kHz |  |  |  |  |
| 24-2: 120KHz SSB support for initial access in FR2-2 |  |  | √ | √ |

Alt2: only define FG 24-1 as basic FG for supporting the most basic deployment scenario (DL-only), while for other deployment scenarios, it can be supported by appropriately defining the pre-requisite FGs.For Alt1, method similar to Rel-16 NR-U can be reused but may complicate UE feature architecture. While Alt2 is a relative simple and flexible way.**Proposal 11: From simplicity and flexibility point of view, propose defining as a basic FG for supporting the most basic deployment scenario (DL-only), while for other deployment scenarios, it can be supported by appropriately defining the pre-requisite FGs.** In this section, we will discuss on the application range of some enhanced features specified in FR 2-2, that is, whether some enhancements can be extended to FR 2-1 and/or FR 1.For the existing FGs discussed for NR above 52.5GHz, we think that it will be limited to FR2-2 by default. In this regard, we need to further discuss whether some of FGs can be applied to FR 2-1 and/or FR 1. Wherein, the principles for judging whether can be extended to FR 2-2 and/or FR 1 are as follows:1. Whether it is beneficial to FR1 and/or FR 2-1;
2. Whether it is compatible with the existing FR1 and/or FR 2-1 features;
3. Whether it is only applicable to unlicensed band or licensed band or both;

For the following enhanced FGs in FR 2-2, we will share our preference on whether it can be applied to FR1 and/or FR2-1:* Multiple PDSCH scheduling by single DCI (e.g., FG 24-1d)

In FR 2-2, multiple PDSCH scheduling by single DCI is applied to the licensed and unlicensed spectrum operation to unify design requirement. Besides, this enhancement is beneficial to degrade the overhead of DCI signalling. So considering signalling overhead, we think it can be considered as a feature to be applied to FR 2-1 and FR 1 and no differentiation licensed and unlicensed spectrum.* Multiple PUSCH scheduling by single DCI(e.g., FG 24-1e)

In FR1, multiple PUSCH scheduling by single DCI has been supported but only continuous PUSCH scheduling by single DCI is introduced. And such enhancement has not been introduced in FR 2-1. However, FR 2-2 supports non-continuous and continuous PUSCHs in time-domain scheduled by single DCI, which is different with that of FR1. In order to reduce signalling overhead, it is beneficial to extend this feature for FR 1 and even for FR 2-1.**Proposal 12: Enhancements on multiple PUSCH/PDSCH scheduling by single DCI can be considered to be applied to FR1 and FR2-1 as optional features.** |
| Nokia/Nokia Shanghai Bell [6] |  |
| NTT DOCOMO, INC. [7] | A general issue would be how to consider FR-related differentiation. In this WI, companies discuss on various types of new features and enhancements of the existing NR functionalities to extend NR to 52.6 – 71 GHz frequency range. Any UE feature to be supported in this WI will then be applicable at least for 52.6 – 71 GHz. However, companies may or may not argue that some of the UE features to be specified in this WI could be technically beneficial even in another frequency range, and then desire to discuss whether/how to expand the applicability of such UE features to other frequency ranges. It may consume quite a lot of time in RAN1 to discuss the range of applicability one by one. Note that 52.6 – 71 GHz frequency range at least include unlicensed bands, while licensed bands may also be identified in the future. The WI also target the support for both licensed and unlicensed band in this frequency range. This fact may also make the discussion more complex. Also, frequency range notation itself should be carefully considered. In the latest WID for supporting NR from 52.6 GHz to 71 GHz [2], two important aspects on frequency range definition regarding beyond 24 GHz are captured; one is to extend the definition of FR2 up to 71GHz, and the other is to introduce new FR sub-labels, FR2-1 and FR2-2, to be used for differentiating 24.25 – 52.6 GHz and 52.6 – 71 GHz if needed. Therefore, as well as FR1/2 differentiation, FR2-1/2-2 differentiation may also need to be considered. With the consideration above, how to have FR-related differentiation would depend on each UE feature in our view. We see the following alternatives at this stage.* One potential approach to easily solve this issue could be to define all the UE features to be specified in this WI per-band (or per BC). With this, UE can report its capability regarding functionalities for 52.6 – 71 GHz operation per band that the UE supports, which means vendors have a freedom for its own implementation. However, it may increase the overhead for UE capability signalling depending on the number of bands/band combinations to be specified.
* For UE features which can be applied regardless of licensed or unlicensed band, extending per-FR capability signalling may be another possibility. For example, by enabling per-FR capability signalling to differentiate FR2-1 and FR2-2, it would be possible to indicate a certain UE feature is applicable for FR2-2 only if needed. Or, if a UE feature is applicable to both FR2-1 and FR2-2 without any difference, just to use the existing per-FR capability signalling would also be possible. By defining in this manner, vendors still have a freedom to implement a certain feature for a certain frequency range, while overhead for capability signalling can be suppressed.
* To decrease signalling overhead more, per-UE signalling with some Notes can also be considered. This approach, however, may be applicable to particular UE features only, for which the targeted FR is crystal clear. For example, if a UE feature is clearly applicable for FR2-2 unlicensed band only, it could be possible to define it as a UE feature with per-UE capability signalling with a Note saying i.e., “this is applicable only for unlicensed band in FR2-2”. While this approach achieves much less overhead on UE capability signalling, an issue may be less implementation flexibility.

Table 1. Comparison of FR differentiation approaches

|  |  |  |
| --- | --- | --- |
| FR differentiation | Flexibility for implementation  | UE capability signalling overhead |
| Per-band  | Very flexible | Heavy  |
| Per FR | Less flexible  | Relatively light |
| Per UE | Much less flexible | Light  |

**Proposal 1:** For the discussion on Rel-17 UE features at least regarding 52.6 – 71 GHz WI, the following alternatives can be considered in case-by-case manner, in terms of FR differentiation. * Alt 1: define as per-band
* Alt 2: define as per-FR
	+ Differentiation of FR2-1/2-2 may or may not be needed
* Alt 3: define as per-UE
	+ A fixed limitation (e.g., as a Note) on applicable frequency range may be needed

In Appendix, we show a brief set of analysis regarding Rel-15/16 UE features in terms of applicability to 52.6 – 71 GHz frequency range, based on the UE features specified in 38.822 [2], where we have focused with the principles below: * Check mandatory UE features in Rel-15/16 if it is applicable to 52.6 – 71 GHz frequency range
* Check UE features with per-UE signalling if it is applicable to 52.6 – 71 GHz frequency range when it is reported applicable to FR2
* For UE features with per-FR capability signalling, we have not analysed yet since it may be straightforward that per-FR signalling will indicate sub-FR level applicability, although it needs further discussions
* For UE features with per-band or per-BC capability signalling, we have checked only for the ones supported in Rel-16 NR-U

Below are some particular aspects that may require discussionsSome UE features are defined as mandatory for NR in Rel-15. It has to be supported even for UEs supporting Rel-17 functionalities. However, they didn’t consider the operation in 52.6 – 71 GHz when specified, especially with larger SCSs. Therefore, some UE features, even the ones defined as mandatory in Rel-15/16, may or may not be feasible in case of the operation in 52.6 – 71 GHz frequency range. One potential issue among the mandatory features is related to FG3-1 on basic DL control channel, with the following components:

|  |
| --- |
| 1) One configured CORESET per BWP per cell in addition to CORESET0* CORESET resource allocation of 6RB bit-map and duration of 1 – 3 OFDM symbols for FR1
* For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSSs, CORESET resource allocation of 6RB bit-map and duration 1-3 OFDM symbols for FR2
* For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 1-2 OFDM symbols for FR2
* REG-bundle sizes of 2/3 RBs or 6 RBs
* Interleaved and non-interleaved CCE-to-REG mapping
* Precoder-granularity of REG-bundle size
* PDCCH DMRS scrambling determination
* TCI state(s) for a CORESET configuration

2) CSS and UE-SS configurations for unicast PDCCH transmission per BWP per cell* PDCCH aggregation levels 1, 2, 4, 8, 16
* UP to 3 search space sets in a slot for a scheduled SCell per BWP
* This search space limit is before applying all dropping rules.
* For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot
* For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot

3) Monitoring DCI formats 0\_0, 1\_0, 0\_1, 1\_14) Number of PDCCH blind decodes per slot with a given SCS follows Case 1-1 table5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot per scheduled CC for TDD |

For UEs supporting NR from 52.6 GHz to 71 GHz, at least the operation with 120 kHz SCS is to be supported. As 120 kHz SCS is the one which was supported in Rel-15/16 NR already, it does not cause any issue to support the existing UE features, including the ones specified as mandatory, e.g., FR3-1. However, the UEs supporting NR in 52.6 – 71 GHz may support larger SCS(s), i.e., 480 and/or 960 kHz SCS, as well in order to achieve the operation with larger absolute bandwidth per CBW. Since symbol duration is scaled based on SCS in the same manner as in FR1 and FR2, and definition of slot is same as in Rel-15/16 NR, the operation with 480/960 kHz SCS automatically means the one with shortened duration of a slot. When operating with shortened duration of a slot by supporting 480 and/or 960 kHz SCS, some components supported as mandatory in FG3-1 may not be feasible. For example, in the second component, up to 3 search space sets in a slot for a scheduled SCell per BWP is supported. Since NR in 52.6 – 71 GHz will be operated with SCS of 120 kHz or larger, whether up to 3 SS sets in a slot is always possible may not be clear. Moreover, in the sixth component, per-slot and per-CC maximum limitation of DCI processing is described, where one unicast DCI scheduling DL and 2 unicast DCI scheduling UL are supported. The feasibility of this may also be affected by shortened duration of a slot, e.g., only smaller number of DCIs may be possible for UE to process per slot with shortened time duration. Given above, we propose to discuss on how to interpret FG3-1 for the operation with SCS of 480 and/or 960 kHz. We see some alternatives to deal with the situation can be considered; one is to add a Note in a new UE feature to support 480 and 960 kHz SCS in 52.6 – 71 GHz frequency range such as “[a certain components of] FG 3-1 is not applicable to the SCS supported by this FG”. **Proposal 4:** For UEs supporting NR in 52.6 – 71 GHz frequency range, how to treat a mandatory UE feature, FG 3-1, should be discussed at least when the UE supports the operation with 480 and/or 960 kHz SCS As well as mandatory UE features, UE features with per-UE capability signalling also need to be checked in terms of their applicability to the operation in 52.6 – 71 GHz. When UEs report their support of a certain UE feature with per-UE capability signalling, NW will understand that the UE supports the feature regardless of the operating band, frequency range (or even duplex). However, it may not always the case that UE features with per-UE capability signalling are applicable to 52.6 – 71 GHz when it is applicable to the existing frequency ranges. Our brief analysis is shown on the 6th column on the tables in Appendix. We generally believe most of the UE features with per-UE capability signalling are also applicable to FR2-2 as well. On the other hand, to support such UE features in practice in 52.6 – 71 GHz frequency range, some maintenances in the specifications will be needed, especially in terms of SCS. For example, FG 12-6 is a UE feature with per-UE capability signalling to report whether the UE supports DL SPS with the periodicity shorter than 10 ms. In Rel-16, an RRC parameter *periodicityExt-r16* is supported for configuring DL SPS periodicity shorter than 10 ms. However, how to use the value configured via *periodicityExt-r16* has not been defined in case that larger SCS than 120 kHz is configured. In other words, even if the UE feature reporting is supported for NR in 52.6 – 71 GHz as it is, when larger SCS than 120 kHz is used, this functionality (i.e., DL SPS with shorter than 10 ms periodicity) cannot be configured in practice. **Observation 1:** While most of Rel-15/16 UE features with per-UE capability signalling can be reused as they are for UE to report their support for NR in 52.6 – 71 GHz, some maintenances will be required in the specifications to support the functionalities in practice. **Proposal 5:** For Rel-15/16 UE features with per-UE capability signalling, whether to be applicable to FR2-2 when they are reported as applicable should be analysed a case-by-case mannerThere would be other types of UE features in NR in terms of FR differentiation, that is, UE features with per-FR/band/BC capability signalling. For the ones with per band/BC capability signalling, we do not see the need to check their validity since per-band/BC signalling naturally differentiate FR2-2 as well as the other FRs. Thus we do not incorporate them with the table in Appendix. On the other hand, some UE features with per-band/BC signalling include a Note associated with FR and/or whether it is licensed or unlicensed. For example, FG22-6/7 on PUCCH grouping, there are the descriptions on carrier type, which differentiate between the existing FRs and licensed/unlicensed band for FR1. Here, whether “FR2” can include 52.6 – 71 GHz or not is unclear at this stage. Moreover, as 52.6 – 71 GHz includes unlicensed bands, differentiation between licensed/unlicensed band may be required even if the wording “FR2” is kept as it is. **Proposal 6:** For Rel-15/16 UE features with per-FR capability signalling, * If FR-related description is included in e.g., component, whether/how to consider 52.6 – 71 GHz may need to be discussed.
* Otherwise, as it can naturally differentiate FR2-2 from other FRs, there is no need to discuss in terms on FR2-2

The ones with per-FR capability signalling may not have any issue either since Rel-15/16 defines FR2 as a frequency range between 24.25 – 52.6 GHz. Also, even if FR2-2 is additionally considered, as well as FR1/2-1 differentiation which has already been done via per-FR capability signalling, FR2-2 will need to be differentiated from the other FRs in many cases. Given that, we have not analysed yet on the ones with per-FR capability signalling on the tables in Appendix.An issue which may be lying on the ones with per-FR capability signalling would be whether to be applicable when they are reported as applicable to FR2 if no differentiation between FR2-1 and FR2-2 is considered. Some could be applicable to FR2-2 in the same manner as to FR2-1, while some others may not. This issue may also need to be checked in a case-by-case basis. We think it should also be discussed in RAN1 in the future. **Proposal 7:** For Rel-15/16 UE features with per-FR capability signalling, how to treat when it is reported as applicable to FR2 should be discussed* Option 1: Differentiation between FR2-1 and FR2-2 is introduced
* Option 2: All the UE features are treated as applicable or inapplicable to FR2-2 as well as FR2-1 when it is reported for FR2, while the ones for which such treatment cannot be appropriate are defined as exceptional cases via e.g., adding Note

For the ones with per-band signalling, at least how to treat the ones related to Rel-16 NR-U is worth more clarification in our view. For example, FG10-2 is defined for “SSB-based RRM with Q with dynamic channel access mode”, which is the same functionality as DBTW to be supported for FR2-2. Thus, it can be reused to report that a UE supports RRM with DBTW in FR2-2 by reporting FG10-2 with a band in FR2-2. On the other hand, there has already been some new FGs agreed for FR2-2, which is the same as (or similar to) the existing one for Rel-16 NR-U, e.g., multi-PUSCH scheduling. To align with how to treat Rel-16 NR-U FGs, all the functionalities supported for FR2-2 unlicensed band need to be re-defined, even if the same (or similar) FG has been defined in Rel-16 NR-U already. We believe this aspect should be clarified more. **Proposal 8:** How to treat Rel-15/-16 UE features with per-band (at least the ones defined for Rel-16 NR-U) should be clarified. * *Alt-1: The existing FG (e.g., FG10-2 for RRM with DBTW) is reused to report that the UE supports it in FR2-2 by indicating for a band in FR2-2.*
* *Alt-2: A dedicated FG is newly defined for any functionality supported in FR2-2, even if the same functionality has already been defined for Rel-15/-16*

Moreover, we believe additional FG(s) need to be defined for HARQ-ACK bundling. We believe it should be associated with the support of multi-PDSCH scheduling. Since separate FG is defined multi-PDSCH scheduling per SCS, the FG for HARQ-ACK bundling may also have to be defined per SCS. Another issue is whether to have a unified FG for both Type 1 and Type 2 HARQ-ACK codebook. We are open for this issue. Based on that, we suggest adding the following. Note that we are also fine with merging FG24-11 and FG24-11a, FG24-12 and FG24-12a, and FG24-13 and FG24-13a (i.e., having single capability for each SCS on HARQ-ACK bundling). **Proposal 4:** Adde new FGs for HARQ-ACK bundling, e.g., as in Table 2.2-2* It should be per SCS
* It can be per type of HARQ-ACK codebook

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK bundling for Type 1 HARQ codebook multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| Intel Corporation [8] |  |
| Ericsson [9] | In RAN1#107bis-e, the following conclusion was reached:**Conclusion**Potential indications of UE capability related to a limited support of cross-carrier scheduling e.g. as a function of |μPDCCH − μPDSCH| can be discussed as part of the UE capability discussion.We do not support addition of such a UE capability. RAN4 has defined inter-band carrier aggregation combinations between FR1 and FR2-2, and given that FR1 bands are defined with SCS as low as 15 kHz and that FR2-2 bands are defined with SCS up to 960 kHz, we don't think that additional SCS restrictions should not be introduced if the UE supports such a band combination. This would mean that the SCS difference can be as large as |μPDCCH − μPDSCH| = 6.1. Do not introduce a UE capability on the supported value(s) of the SCS difference |μPDCCH − μPDSCH| for cross-carrier scheduling.
 |
| Apple [10] | 1. In RAN1 #107-bis-e, the following conclusion was reached [2]:

|  |
| --- |
| ConclusionPotential indications of UE capability related to a limited support of cross-carrier scheduling e.g. as a function of |μPDCCH − μPDSCH| can be discussed as part of the UE capability discussion. |

* 1. In a scenario with different numerologies between PDSCH and PUCCH, a large differential between the SCSs may result in a large gap between a transmitted PDSCH(s) and its corresponding PUCCH. In one simple example, assume that the transmission occurs such that the HARQ is on FR1 with the SCS set to 15 kHz which is equivalent to 32 480 kHz slots. A frame structure of DDDSU would require an aggregation of up to 96 slots. The maximum differential changes from 8 (120 kHz to 15 kHz) to 64 (960 kHz to 15 kHz). As such, a UE should be able to signal a value K such that |μPDCCH − μPDSCH| ≤ k, where k ≥ 3.
	2. *Secondly, the maximum number of carriers that can be simultaneously scheduled from a single carrier should be defined as a UE capability.* This may be necessary given the possible increase in the bandwidth of the different transmissions, and the increase in data rate for the new SCSs.
 |
| Samsung [11] |  |
| MediaTek Inc. [12] | In RAN1 #106bis e meeting, the following agreement regarding m-TRP multi-PDSCH scheduling reception is achieved.Agreement:The working assumption in RAN1#106-e is confirmed with the following update:For multi-PDSCH scheduling for multi-TRPs, support a single DCI field ‘Transmission Configuration Indication’ as in Rel-16 TCI state indication mechanism for multi-TRPs* The single DCI field ‘Transmission Configuration Indication’ indicates one or two TCI states associated with a code point for single DCI based multi-TRP mechanism
	+ When two TCI states are indicated, reuse Rel-16 association rules to apply the two TCI states for each PDSCH scheduled by a multi-PDSCH scheduling DCI
* The single DCI field ‘Transmission Configuration Indication’ indicates only one TCI state associated with a code point for multi-DCI based multi-TRP mechanism
* Reuse Rel-16 RRC configuration and MAC CE activation/deactivation methods for the one or two TCI states
* ~~FFS: Details of multiple TCI state association with multiple PDSCHs~~
* Within the TDRA table for multi-PDSCH scheduling, the UE does not expect to be configured with the higher layer parameter repetitionNumber

To allow UE to support m-TRP single-PDSCH scheduling and only s-TRP multi-PDSCH scheduling, we suggest to introduce additional FGs for m-TRP multi-PDSCH scheduling.Proposal 5: Add FGs for m-TRP multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1g | Single-DCI based SDM scheme multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4g | Single-DCI based SDM scheme multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5g | Single-DCI based SDM scheme multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |

 |
| Qualcomm Incorporated [13] |  |
| LG Electronics [14] | In [2], it was proposed to add new feature groups corresponding to time domain HARQ-ACK bundling which is introduced to bundle HARQ-ACK information of multiple PDSCHs scheduled by a single DCI. We tend to agree that new feature groups are required for indicating if a UE supports time domain HARQ-ACK bundling. However, different from [2] where feature groups are created per SCS per codebook type, in order to reduce the overhead of UE capability signaling, it is preferable to add corresponding feature groups depending on codebook types (not depending on SCS values).**Proposal #5: Add FGs 24-11 and 24-11a corresponding to HARQ-ACK time domain bundling for multi-PDSCH scheduling for type-1 and type-2 HARQ-ACK codebook, respectively, as follows.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK time domain bundling for Type-1 HARQ-ACK codebook for multi-PDSCH scheduling | Support HARQ-ACK time domain bundling for Type-1 HARQ-ACK codebook for multi-PDSCH scheduling | 24-1d or 24-4 or 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK time domain bundling for Type-2 HARQ-ACK codebook for multi-PDSCH scheduling | Support HARQ-ACK time domain bundling for Type-2 HARQ-ACK codebook for multi-PDSCH scheduling | 24-1d or 24-4 or 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |

# Discussion/Approval Items during RAN1 #108-e — First Checkpoint

After review of contributions submitted to RAN1 #108-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #108-e.

**General comments**

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 1: FG 24-1

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 2: FG 24-1a

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 3: FG 24-1b

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[A UE that supports FG 24-2 must indicate this FG is supported]~~~~[~~Note: This FG is only supported in bands under PSD limitation in ~~for~~ shared spectrum operation~~]~~ | Optional withcapability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 4: FG 24-1c

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 5: FG 24-1d

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A | ~~FFS: to extend this FG to other frequency ranges~~ This feature group is applicable to both FR2-1 and FR2-2 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 6: FG 24-1e

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A | ~~FFS: to extend this FG to other frequency ranges~~This feature group is applicable to both FR2-1 and FR2-2 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 7: FG 24-2

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 8: FG 24-3

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 9: FG 24-4

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)~~FFS:~~ 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where ~~set2~~ = (4, 3) and (7, 3) are supported ~~symbols where set2 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD ~~(This supersedes corresponding component of FG 3-5b)~~6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD ~~(This supersedes corresponding component of FG 3-5b)~~ 7. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Per band | N/A | N/A | N/A | ~~FFS: component description without a reference to other R15 FGs~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 10: FG 24-4a

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 11: FG 24-4b

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~[~~Note: This FG is only supported in bands for shared spectrum operation~~]~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 12: FG 24-4c

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 13: FG 24-4f

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)=(4,2)2.) Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~3.) For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | 24-4 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~Component 1 candidate values: [one or more of] {[(2,1),] (4,2) }~~~~Note: If (2,1) is not agreed, this FG will have no component candidate values and the component 1 description will be updated from (Xs,Ys) to (Xs,Ys)=(4,2) similar to FG 24-4 and 24-5~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 14: FG 24-5

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)~~FFS:~~ 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4~~3~~. Within the Ys = 1 slot (with Xs=8), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) ~~set1~~ = (7, 3) symbols ~~where set1 is defined in FG3-5b (FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~5~~4~~. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD ~~(This supersedes corresponding component of FG 3-5b)~~6~~5~~. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD ~~(This supersedes corresponding component of FG 3-5b)~~7. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Perband | N/A | N/A | N/A | ~~FFS: component description without a reference to other R15 FGs~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 15: FG 24-5a

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-1a, 24-5 | Yes | N/A | 960KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 16: FG 24-5c

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 17: FG 24-5f

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)2.) Within each of the Ys = 1, 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot ~~(FFS: Monitoring capability within slots of type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS)~~3.) For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of each slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within each slot of the slot group. | 24-5 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 18: FG 24-6

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 19: FG 24-7

After review of contributions submitted to RAN1 #108-e in this agenda item, nothing is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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| Company | Comments/Questions/Suggestions |
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# Issue 20: FG 8

 ***[This proposal is discussed in the following separate email discussion. Please provide comments/questions/suggestions there]***

[108-e-R17-UE-features-32HARQ] Email discussion on UE features for 32 HARQ processes – Ralf (AT&T)

* Check point on February 23
	+ If there is no consensus at the Feb 23 check point, email thread will be closed

# Issue 21: FG 9

 ***[This proposal is discussed in the following separate email discussion. Please provide comments/questions/suggestions there]***

[108-e-R17-UE-features-32HARQ] Email discussion on UE features for 32 HARQ processes – Ralf (AT&T)

* Check point on February 23
	+ If there is no consensus at the Feb 23 check point, email thread will be closed

# Issue 22: FG 10

After review of contributions submitted to RAN1 #108-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d = 56 symbols for 480 kHz SCS | ~~Yes~~ | ~~N/A~~ Yes | ~~[Additional beam switching time delay is not supported]~~ N/A | ~~[Per UE/per band]~~ Additional beam switching time delay d = 56 symbols is not supported for 480kHz SCS | ~~N/A~~ per band | N/A | N/A | ~~Yes~~ N/A | ~~Candidate value set: 56 or 112 symbols~~If this capability is not reported and the UE supports both FG 24-4 and 24-5, the default value of 112 symbols is assumed | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 23: New FGs

The following new FGs were proposed in contributions submitted to RAN1 #108-e in this agenda item. **Please indicate in the table below which of these proposed FGs should be discussed during RAN1 #108-e.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK bundling for Type 1 HARQ codebook multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1g | Single-DCI based SDM scheme multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4g | Single-DCI based SDM scheme multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5g | Single-DCI based SDM scheme multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14 | Sub-carrier spacing difference for cross-carrier scheduling | Supported value(s) k of the Sub-carrier spacing difference |μPDCCH − μPDSCH| for cross-carrier scheduling such that |μPDCCH − μPDSCH| ≤ k where k ≥ 3 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Discussion/Approval Items during RAN1 #108-e — Second Checkpoint

Based on the comments/questions/suggestions received by the first checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 3 will not be considered]***

**General comments**

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| --- | --- |
| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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# Discussion/Approval Items during RAN1 #108-e — Third Checkpoint

Based on the comments/questions/suggestions received by the second checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 4 will not be considered]***

**General comments**

|  |  |
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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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# Summary of Final Proposals for Agreements

This Section summarizes the final proposals for agreement in RAN1 #108-e by email. There are no tables for comments.

***[All comments must be directly made on the RAN1 email reflector]***

Companies can continue to update their comments in the previous Sections, however, these are no longer monitored by the moderator. Any such comments will be for archival purposes only and will not influence the outcome of this email discussion. Any objection to any of the proposals in this Section must be voiced directly on the RAN1 email reflector.

**Possible Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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# Conclusion

After further discussion on the RAN1 email reflector the following was agreed as part of this email discussion:

# References

1. R1-2200780, Updated RAN1 UE features list for Rel-17 NR after RAN1 #108-e, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2200958, Rel-17 UE features for extension to 71 GHz, Huawei/HiSilicon
3. R1-2201121, Discussions on UE features for NR operation from 52.6GHz to 71GHz, vivo
4. R1-2201302, Discussion on UE features for FR2-2, OPPO
5. R1-2201395, Discussion on UE features for 52.6 to 71GHz, ZTE/Sanechips
6. R1-2201409, On UE features for supporting NR from 52.6 GHz to 71 GHz, Nokia/Nokia Shanghai Bell
7. R1-2201502, Views on Rel-17 UE features for supporting NR in FR2-2, NTT DOCOMO, INC.
8. R1-2201727, Discussion on UE capability for extending NR up to 71 GHz, Intel Corporation
9. R1-2201741, UE features for extending current NR operation to 71 GHz, Ericsson
10. R1-2201792, Views on Rel-17 Beyond 52.6 GHz UE features, Apple
11. R1-2202039, On UE features for supporting NR from 52.6 GHz to 71 GHz, Samsung
12. R1-2202075, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, MediaTek Inc.
13. R1-2202166, UE features for NR from 52.6 Ghz to 71 Ghzm Qualcomm Incorporated
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